The Engineer

SEPTEMBER 11, 1953 28, ESSEX ST., STRAND, LONDON, W.C.2. TWO SHILLINGS

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## *Steam Valves and Water Clocks*

**Ctesibius of Alexandria is said to have invented the pump about 120 B.C. He certainly made a Clepsydra or Water Clock, in which the moving power was a falling column of water controlled, no doubt, by some form of valve or clack.**

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**Ctesibius was a pioneer in his time: Baines in ours. The Bestobell "Victor" Valve was introduced in 1919 and was, we believe, the first bronze valve to employ a stainless steel seating, and it still holds its place today as the finest steel mounted valve for steam pressures up to 350 p.s.i. at 550°F.**

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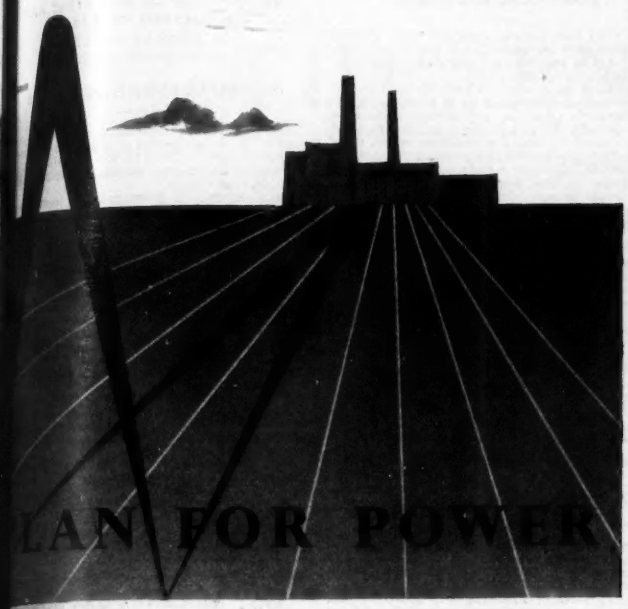


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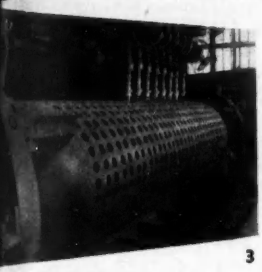
3

1. *Power expanding of tubes inside a boiler drum.*
2. *One of two Raymond Bowl Mills and exhauster fans firing one water-tube boiler.*
3. *Multiple spindle machine trepanning tube holes after fabrication.*

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# THE ENGINEER

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**NOTICE TO READERS**
All letters intended for insertion in 'The Engineer' or containing questions should be accompanied by the name and address of the writer, not necessarily for publication, but as a proof of good faith. No notice whatever can be taken of anonymous communications. No undertaking can be given to return drawings or manuscripts; correspondents are therefore requested to keep copies.

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Advertisements received by Mid-day Tuesday will appear in the issue of Friday the same week. Orders must be accompanied by a remittance.

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## PUBLIC APPOINTMENTS

### BRISTOL EDUCATION COMMITTEE

#### COLLEGE OF TECHNOLOGY, BRISTOL

#### APPOINTMENT OF PRINCIPAL

Applications are invited for the post of PRINCIPAL, which will become vacant on 31st August, 1954. The College is recognised as the Regional College for a large part of the South-West of England, providing the following departments: Science, Pharmacy, Navigation, Engineering, Building, Printing, and Women's Subjects. Present enrolments, full-time, part-time day and evening exceed 5500. There is being provided at present a very considerable extension of fully equipped premises giving ample scope for expansion of facilities.

The salary scale is at present £1640 by £50 to £1840.

Candidates should be highly qualified and have had responsible experience either in the field of technical education or administration, or in industry; preferably in both. Applications from any quarter will be considered on their merits.

Forms of application (returnable within six weeks of the appearance of this advertisement), together with full details of the post, are obtainable from the undersigned.

G. H. SYLVESTER,
Chief Education Officer.

Council House,
College Green,
Bristol, 1. E5183

### CIVIL SERVICE COMMISSION

#### SCIENCE MUSEUM

#### GUIDE LECTURER

The Civil Service Commissioners invite applications from men for a post of GUIDE LECTURER in the Science Museum. Age at least 30 on 1st September, 1953. Candidates should possess a Degree or equivalent qualification in Science or Engineering. Some experience of lecturing is desirable.

Duties comprise preparation and delivery of lectures (with appropriate visual aids) in the Lecture Theatre on subjects illustrated in the Engineering Sections; conducting parties on lecture tours round the galleries; undertaking such other duties as may be assigned by the Director.

Inclusive salary scale £681–£838 until satisfactory completion of training period (normally twelve months). Thereafter £970–£1151.

Further particulars and application forms from Civil Service Commission, Scientific Branch, 7th Floor, Trinidad House, Old Burlington Street, London, W.1, quoting No. S 4248/53. Completed application forms must be returned by 1st October, 1953. E5204

### TRINITY HOUSE

#### ENGINEERING ASSISTANTS

ENGINEERING ASSISTANTS wanted.—Applications are invited for (a) One Engineering Assistant Grade II (Civil), and (b) One Engineering Assistant Grade II (Mechanical), on the staff of the Corporation of Trinity House, the General Lighthouse Authority for England and Wales. Candidates must be medically fit, about 27 years of age, of British Nationality and for (a) be Graduates of the Institution of Civil Engineers, and for (b) Graduates of the Institution of Mechanical Engineers or possess exempting qualifications. Applicants (a) should possess experience in the preparation of plans, specifications and quantities for general building and civil engineering works, surveying and levelling, and be capable draughtsmen. Some knowledge of Dock and Harbour works including reinforced concrete and sheet piling work would be of advantage. Applicants (b) should have served an engineering apprenticeship, be capable draughtsmen and possess experience in the installation of internal combustion engines, air compressors, auxiliary equipment and pipework. Some electrical experience would be of advantage. The appointments are permanent and pensionable subject to one year's probation in accordance with Civil Service practice. Salary, inclusive of Pay Addition and Extra Duty Allowance, £673 by £20 (basic) to £793 per annum Consolidated.—Applications should be made in writing to the Secretary, Trinity House, Tower Hill, London, E.C.3, not later than 28th Sept., 1953, stating age, present occupation, qualifications and experience and enclosing copies of three recent testimonials. E5235

### MINISTRY OF WORKS

#### CIVIL ENGINEER (MAIN GRADE)

The Civil Service Commissioners invite applications for a pensionable post in charge of the Soil Mechanics Laboratory, Kidbrooke, London, S.E.3.

Age at least 30 on 1st August, 1953. Candidates must (a) hold Corporate Membership of the Institution of Civil Engineers and should preferably also hold an Honours Degree in Civil Engineering; (b) have had experience in the use of all types of apparatus associated with a Soil Mechanics Laboratory and be familiar with methods of assessing both soil and ground water characteristics; (c) have had practical experience in the field and be familiar with the application of the principles of soil mechanics to problems such as the assessment of the bearing capacity of various types of soil, the compaction of soils and also soil stabilisation; (d) be familiar with all forms of piling and pre-piling boring operations. A knowledge of modern concrete technology and of bituminous road materials would be an advantage.

Salary: £1000–£1320. Exceptionally, a starting salary above the minimum may be given in appropriate cases.

Particulars and application forms from Civil Service Commission, Scientific Branch, Trinidad House, Old Burlington Street, London, W.1, quoting No. S4245/53. Applications to be returned by 1st October, 1953. E5198

## PUBLIC APPOINTMENTS

### HER MAJESTY'S COLONIAL SERVICE

#### PUBLIC WORKS DEPARTMENT, KENYA

#### DEPUTY MECHANICAL ENGINEER

Applications are invited for the following post: DEPUTY MECHANICAL ENGINEER, Public Works Department, Kenya.

Duties are to assist the Mechanical Engineer in the purchase, administration and general control of construction and fixed plant, personnel and workshops in Kenya. Appointment is either pensionable on probation in the salary scale £655–£1320 per annum, or on contract for one tour of 40/48 months in the salary scale £830–£1410 per annum, point of entry depending on experience and war service. On satisfactory completion of contract a gratuity of 13½ per cent of total substantive salary is payable. In either case there is a temporary cost-of-living allowance of 30 per cent (maximum £300). Free passages are granted for an officer, his wife and children, up to a maximum cost of 3 adult passages on appointment and on leave. Government quarters, if available, are provided at a rental of 10 per cent if furnished and 7½ per cent of salary if unfurnished. Leave is granted at the rate of 4½ days for each month of resident service at the end of each tour.

Candidates not above 35 years of age should have an Engineering Degree of a recognised University granting exemption from sections A and B of the examination for Associate Membership of the Institution of Mechanical Engineers and should be sufficiently experienced to relieve the Mechanical Engineer of some of the duties mentioned above and be capable of taking over all duties when the Mechanical Engineer is absent.

Apply in writing to the Director of Recruitment, Colonial Office, Great Smith Street, London, S.W.1, giving briefly age, qualifications and experience. Mention the reference number CDE 112/7/013. E5234

### COMMONWEALTH RELATIONS OFFICE

#### AGRICULTURAL ENGINEERING DIVISION OF THE DEPARTMENT OF AGRICULTURE

#### AGRICULTURAL ENGINEER

The Commonwealth Relations Office invites applications under the Colombo Plan for an appointment as AGRICULTURAL ENGINEER to advise the Agricultural Engineering Division of the Department of Agriculture at Peredeniya, Ceylon, on (i) head office administration, (ii) repair shop management and operation, (iii) tractor and machinery pool depots, (iv) irrigation pumping machinery, (v) farm machinery development, (vi) dairy equipment, (vii) cotton ginning plant, (viii) buildings, (ix) training of personnel. Duration one year.

Salary £1400 p.a. plus tax-free allowance of £830 p.a. for a married man, plus children's allowance, also board and lodging allowance. Free return passage for appointee and dependants, free medical attention.—Further details from Ministry of Labour and National Service (quote A.12/CE.359/53), Almack House, 26, King Street, S.W.1. E5203

### DERBY NO. 3 HOSPITAL MANAGEMENT COMMITTEE

#### THE PASTURES HOSPITAL, MICKLEOVER, DERBY

#### GROUP ENGINEER

GROUP ENGINEER required. Salary, £715 by £25 to £815. Candidates should hold not less than one of the following qualifications:—

Higher National Diploma in Mechanical Engineering.

Higher National Certificate in Mechanical Engineering.

Diploma in Mechanical Engineering of a recognised Technical College.

Extra First Class or First Class Certificate of Competency in Marine Engineering or equivalent Naval Certificate.

An unfurnished house at a moderate rent is available for the successful candidate.

The successful candidate will be required to pass a medical examination. The post is subject to the National Health Service (Superannuation) Regulations.

Applications, together with the names of three referees, should be received by the Group Secretary not later than 25th September, 1953. E5233

### THE SOUTH STAFFORDSHIRE WATERWORKS COMPANY,

#### 50, SHEEPCOTE STREET, BIRMINGHAM, 15

#### APPOINTMENT OF CIVIL ENGINEERING ASSISTANT

Applications are invited for the above appointment from Chartered Civil Engineers with sound experience in waterworks design and construction. The commencing salary will be £1000 per annum. The successful candidate, if under 45 years of age, will be required to join the company's superannuation and widows' and orphans' schemes, subject to satisfying the conditions of membership, including medical examination.

Applications, stating age, education, qualifications, training and experience, accompanied by the names of two engineers to whom reference may be made, should reach the undersigned on or before the 30th September, 1953.

R. A. Robertson, Esq., B.Sc., M.I.C.E., Engineer-in-Chief. E5225

## PUBLIC APPOINTMENTS

### ADMIRALTY

#### ELECTRICAL ENGINEERS

The Civil Service Commissioners invite applications from men for Main Grade and Basic Grade posts. Age at least 30 for Main Grade and 25 for Basic Grade on 1st April, 1953.

Candidates must have a University Degree with First or Second Class Honours in Engineering, but exceptionally a candidate without this qualification will be considered if he has other qualifications which are particularly suitable; a minimum of two years' practical training followed by practical experience in a responsible electrical engineering post of at least three years for Basic Grade and of eight years for Main Grade or such other experience as the Commissioners consider equivalent.

Inclusive London remuneration on a 45½-hour week.

Basic Grade, £707 (at age 25), then according to age up to £945 at 33. Maximum £1104.

A special increase of £75 is awarded on fulfilment of certain conditions.

Main Grade, £1161–£1548. Exceptionally a starting salary above the minimum of the grade may be granted.

Provincial rates somewhat lower. Promotion prospects.

Full particulars and application forms from Civil Service Commission, Scientific Branch, Trinidad House, Old Burlington Street, London, W.1, quoting S210/53. Completed forms to be returned by 8th October, 1953. E5202

### HIGH COMMISSION OF INDIA

#### INDIA STORE DEPARTMENT

Applications are invited for the undermentioned TWELVE POSTS, nine under Group 1 and 2, and three under Group 3, of Grade III, Technical Officers, to work in the India Store Department, London, in the salary scale of £575–£25–£750–£30–£900 plus pay addition at 10 per cent. on first £500 and 5 per cent. on second £500 of basic salary.

The minimum of £575 is linked to age 25 and is subject to increase at the rate of one increment for each year above that age up to, but not exceeding, age 34, at which point salary is £810 per annum.

The posts are temporary in the first instance and subject to one month's notice on either side, but when made permanent pensionary benefits according to the Rules and Regulations in force at the time will be admissible.

Group I.—Electrical engineering.
Group II.—Mechanical engineering.
Group III.—A. General and Scientific (chemicals).
B. General and Scientific (scientific stores).

Terms and conditions of appointment and standard forms of application may be obtained from "Special Branch," India Store Department, 32/44, Edgware Road, London, W.2 (Tel., Ambassador 4441/116).

The posts for which particulars are required should be stated.

The last date of receipt of application is 22nd September, 1953. E5250

### DEPARTMENT OF SCIENTIFIC AND INDUSTRIAL RESEARCH

#### FOREST PRODUCTS RESEARCH LABORATORY

#### THREE ENGINEERS

THREE ENGINEERS required by Department of Scientific and Industrial Research, Forest Products Research Laboratory, Princes Risborough, Bucks., in the grade of Scientific Officer (unestablished initially), for investigations on timber strength, wood sawing and machining. 1st or 2nd Hons. Engineering Degree (Civil or Mech.), training in the work when in post, knowledge of timber technology not essential. Minimum age 21, preferably under 28. Salary range (under review), £418–£676. Forms from M.L.N.S. Technical and Scientific Register (K), Almack House, King Street, London, S.W.1. Quoting Ref. C99/53A. Closing date 3rd October, 1953. E5199

### NATIONAL COAL BOARD

#### EAST MIDLANDS DIVISION

#### SENIOR ENGINEERING DRAUGHTSMEN

Vacancies exist for TWO SENIOR ENGINEERING DRAUGHTSMEN at No. 5 Area Headquarters, Eastwood. Applicants should possess the Higher National Certificate in Engineering or equivalent, have had a good general experience in colliery engineering and be capable of taking charge and setting out major reorganisation schemes.

Salary will be in the range of £560–£810 per annum.

Applications, giving age and details of qualifications and experience, should be sent within fourteen days of the publication of this advertisement to Area Administrative Officer, National Coal Board, East Midlands Division, No. 5 Area, Eastwood, near Nottingham. E5168

### MINISTRY OF WORKS

#### STRUCTURAL ENGINEERING DIVISION

#### DRAUGHTSMEN

DRAUGHTSMEN required at Edinburgh.

Maximum salary £612 per annum; starting pay according to age, qualifications and experience.

Experience in design and detailing of reinforced concrete or structural steelwork essential.

Apply in writing, giving age and full details of experience, to the Secretary, Ministry of Works, 122, George Street, Edinburgh, 2. E5177

## PUBLIC APPOINTMENTS

### CIVIL SERVICE COMMISSION

#### DEPARTMENT OF SCIENTIFIC AND INDUSTRIAL RESEARCH

NUMERICAL ANALYSIS (THERMODYNAMICS)

#### PRINCIPAL SCIENTIFIC OFFICER

The Civil Service Commissioners invite applications for a permanent and pensionable appointment as PRINCIPAL SCIENTIFIC OFFICER at the Mechanical Engineering Research Laboratory, East Kilbride, near Glasgow.

The work involves ability to lead a team engaged on the thermodynamic tables programme of the Heat Division and the numerical analysis and correlation of experimental data relating to functions of two variables.

Candidates must have been born on or before 31st December, 1921. They must have a First or Second Class Honours Degree, preferably in Mathematics, Physics or Engineering, or equivalent qualifications, and some post-graduate research experience; a candidate without these qualifications may be admitted on evidence of outstanding ability for the post. Candidates should have a high degree of mathematical ability combined with a critical faculty in sifting crude data.

Inclusive remuneration on a 45½-hour week £1063 to £1418 (men), £934 to £1254 (women). Exceptionally a starting salary above the minimum may be granted according to qualifications and experience.

East Kilbride is one of the New Towns and favourable housing prospects exist for the selected candidate.

Further particulars and application forms from the Civil Service Commission, Scientific Branch, Trinidad House, Old Burlington Street, London, W.1, quoting No. S 4247/53. Completed application forms must be returned by 20th October, 1953. E5201

### EAST MIDLANDS GAS BOARD

#### LEICESTER AND NORTHANTS DIVISION

#### DRAUGHTSMAN

Applications are invited for the position of DRAUGHTSMAN in the Divisional Headquarters at Leicester. Grading and salary within the range A.P.T. 6/8 (£490–£665), commensurate with qualifications and experience.

Preference will be given to candidates possessing a recognised engineering qualification and having specialised experience in either installation drawing for gasworks, chemical works or similar plant, pipework installation drawings; reinforced concrete design, or standard steelwork design.

The successful candidate may be required to pass a medical examination, and unless already subject to a pension scheme by virtue of the Gas (Pension Rights) Regulations, 1950, will be required, if eligible, to join the Board's staff pension scheme within six months from taking up the appointment.

Applications, stating age, qualifications, present position and experience, and giving the names of two referees, should reach the undersigned not later than Monday, the 28th September, 1953.

H. B. TAYLOR,
Divisional General Manager.

Millstone Lane,
Leicester,
1st September, 1953. E5063

### COMMONWEALTH RELATIONS OFFICE

#### TRACTOR STATIONS

#### WORKS MANAGER

The Commonwealth Relations Office invites applications under the Colombo Plan for two appointments in Ceylon as WORKS MANAGER for Tractor Stations. Duration one year. Duties: (i) to organise and assist in the operation of tractor pools; (ii) to superintend maintenance and repair; (iii) to train personnel. 175 tractors will be engaged on the mechanised cultivation of paddy in the Dry Zone of Ceylon. Practical experience as above required with a knowledge of the various aspects of mechanical cultivation.

Salary: £1200 p.a., plus tax free allowance of £785 p.a. for a married man plus children's allowance, plus board and lodging allowance. Free return passage for appointee and dependants, free medical attention.

Further details from Ministry of Labour and National Service (quote A.12/CE.379/53), Almack House, 26, King Street, S.W.1. E5197

### THE BRITISH COUNCIL

#### SCIENCE DEPARTMENT

#### ASSISTANT (ENGINEERING)

The British Council invites applications for the post of ASSISTANT (ENGINEERING) in the Science Department, London Headquarters. Candidates must be men, preferably between 30 and 40. Corporate Membership of I.C.E., I.Mech.E. or I.E.E. essential; Engineering Degree desirable; at least three years' practical experience in engineering research or development or education or administration required.

Grade SSO. Inclusive salary range £917–£1075 a year. Contributory pension scheme.

Write, quoting "Engineering" and enclosing stamped, addressed, foolscap envelope, to Director of Personnel Department, British Council, 65, Davies Street, London, W.1, for further particulars and application form, to be returned completed by 25th September. E2420

THE ENGINEER

SEPTEMBER 11, 1953

### Iron and Steel Scrap

THE British Iron and Steel Federation is again reminding industry and the public generally of the importance of home produced scrap. In a letter which has recently been circulated by Captain H. Leighton Davies, chairman of the Federation's scrap committee, it is pointed out that industrialists can be of the greatest help to themselves and the country by taking decisions to scrap all plant, machinery, spares, &c., which are not really needed. An increase in home scrap supplies continues to be essential to the steel industry, especially until gains from increasing pig iron production offset the loss of imported scrap. The letter expresses appreciation of the valuable contribution already made by industrialists and others in speeding up the flow of scrap during last year. But it also suggests that there is still a great deal of scrap available in the form of redundant and obsolete buildings, plant and machinery, some of which would normally be retained for possible future use, but which in present circumstances could be put to much more valuable service by melting into new steel. The joint district scrap committees, which cover the whole country, are at all times ready to help in speeding up the supply of scrap to the steel works.

### The Institution of Mechanical Engineers

THE council of the Institution of Mechanical Engineers is inviting applications from corporate and non-corporate members for a Bryan Donkin award which it is proposed to make next year. The Bryan Donkin Fund was created under the will of the late Bryan Donkin, who died in 1902, and who bequeathed to the Institution a sum of money, the income from which was to be devoted to original research. The purpose of the award, therefore, is to assist any member of the Institution to carry out original research in the science or practice of mechanical engineering. At the present time the amount available for award is approximately £200, the whole or part of which sum may be distributed at the discretion of the council. Candidates are required to submit a programme outlining the research for which the award is required, together with an estimate of the cost of carrying out the research. This should include personal expenses, but in this connection candidates should state the amount of any resources they have available apart from any award which may be received from the fund. Candidates should give the names and addresses of at least two referees as to their personal qualities, training and employment. These referees should preferably be corporate members of the Institution. Applications must also be supported by one referee who can vouch for the practicability of the scheme of work proposed. It should be added that there are no age limits, but that candidates for the award must be British born subjects. Prospective candidates should submit their applications in writing, before January 1, 1954, to the Secretary of the Institution of Mechanical Engineers, Storey's Gate, London, S.W.1.

### Provisional Air Speed Record

LAST Monday, Squadron Leader Neville Duke made two further attempts on the world air speed record in a Hawker "Hunter" interceptor fighter. The first attempt, which he made at noon, consisted of four runs over the 3km course at Littlehampton, when he achieved speeds averaging 716·6 m.p.h. in one direction and 738·7 m.p.h. in the other. The average speed was 727·6 m.p.h., which the Royal Aero Club announces establishes a new record if confirmed by the Fédération Aeronautique Internationale. It will be recalled that last week Squadron Leader Duke made a preliminary attempt on the record, but his speed did not exceed by the required 1 per cent that attained by the American Lieut.-Colonel Barns in a "Sabre" fighter, although this speed of 715·7 m.p.h. has yet to be confirmed. In a later attempt last week, the undercarriage of the "Hunter" developed mechanical trouble and the machine was landed on one-wheel and sustained damage. Staff of the Hawker Aircraft Company, Ltd., worked night and day on the machine and it was not ready until a few hours before the successful attempt last Monday.

### Industrial Design

YESTERDAY, the Council of Industrial Design published its eighth annual report, which presents a record of the work accomplished by the Council and by its Scottish committee during the year ended March 31st last. The report says that last year was a time of consolidation and reorganisation following the achievements of the Festival of Britain in 1951. In returning to more normal conditions of work on a reduced budget, the Council has maintained from the Festival year the selective illustrated index of current designs which was then prepared and which has proved to be the principal link with a number of important manufacturing industries. The record of the Council's activities makes reference, among other matters, to co-operation with the Royal Mint and the Federation of British Industries in encouraging a good standard of design for Coronation medals. There is also reference to work done in the design of street furniture. So far this has consisted mainly of maintaining a list of approved designs of street lighting standards for consultation by local authorities and other organisations, and a committee has been appointed to approve designs submitted by manufacturers. In the twelve months reviewed in the report, this committee, it is stated, received 199 new designs of lighting standards from manufacturers, of which it approved 123 and referred back seventy-six with constructive criticisms. The main object of the work is to improve the day-time appearance of lamp posts, but at the same time the committee hopes to have a "general influence" on street lighting installations and the functional aspects of a column such as strength and durability. It intends also to extend its interest to cover all kinds of street equipment such as bus shelters, outdoor seats, bollards and litter bins. The Council of Industrial Design, it may be recalled, was set up in 1944 by the President of the Board of Trade "to promote by all practicable means the improvement of design in the products of British industry." Its headquarters are at Tilbury House, Petty France, London, S.W.1.

### The Census of Production for 1954

THE Board of Trade has announced that the scope of the census of production to be taken in 1955 in respect of the year 1954, and the information to be obtained, have now been considered by the Census of Production Advisory Committee. It has been decided that all establishments within the field of production will be included in the census, which will be on similar lines to the full census for 1951. The statutory form of return will include questions on working proprietors; number of employees; wages and salaries, &c.; capital expenditure on plant, machinery and vehicles; capital expenditure on new building work; materials and fuel purchased; work given out; stocks at the beginning and end of the year; output, and transport payments. In the wages and salaries section firms will be asked to give information about employers' payments to superannuation and other pension funds, as well as their contributions to all National Insurance schemes. This, it is stated, will help to complete the information available about labour costs. In the materials section, firms will be asked to state, as in the 1948 census, the total cost of materials and fuel purchased with details, by quantity and value, of the principal items. Information will be sought about certain materials which are common to virtually all trades, such as replacement parts and packing materials. In the output section, firms will be asked to show the total value of sales and work done, with details of sales of each of a number of products, on the lines of the detailed form used for 1951. In the light of the information obtained from the censuses for 1948 and 1951, some modifications of the headings in the materials and fuel section and in the output section will be made in the forms used for certain trades. No information will be required about merchanted goods. Details of the output and materials headings which are to be specified for 1954 will be sent for comments to the trade associations concerned as soon as possible. Any firm in the field of production requiring further particulars about the census for 1954 is asked to address its inquiries to the Census of Production Office, Neville House, Page Street, London, S.W.1, stating the nature of the business carried on.

### Atmospheric Noise Measurement

A SURVEY of the investigations made over a period of six years on the phenomenon of atmospheric noise forms the subject of a report, "Measurements of Atmospheric Noise at High Frequencies," which has been published this week by the Department of Scientific and Industrial Research. As the report points out, the success of all forms of radio communication depends upon the establishment of a signal at the receiving station of adequate strength compared with that of the prevailing atmospheric noise. Measurements of atmospheric noise at high-frequencies have been made for several years past, the report states, but the present survey is based upon measurements made during the years 1945–51, during which period improved equipment has been used. A great deal of information at frequencies of 2·5 Mc/s and 5 Mc/s has been obtained and diminishing quantities at frequencies up to 20 Mc/s. The stations are operated by a number of commercial communications companies in various countries and the observations are transmitted for analysis to either the National Physical Laboratory, the American Central Radio Propagation Laboratory, or the Australian Radio Propagation Laboratory. At present there are twenty stations widely spaced over the world. The results obtained during the period under survey confirm the general form of the diurnal, seasonal and spatial variations deduced from earlier measurements and provide more detailed information about them. At 2·5 Mc/s, for example, night-time values are higher than daytime values by amounts ranging from about 20 db in temperate latitudes to more than 40 db in some tropical thunderstorm areas. With the increase of frequency the noise decreases in intensity and the diurnal variation becomes smaller. No definite correlation between noise intensity and the sunspot cycle has been proved. The report discusses the accuracy of measurement of noise, the effect of receiver noise on the measurements and the way in which results are interpreted and analysed. A comparison is made between measured and predicted noise levels by night and by day, and the report suggests further lines of investigation which might be expected to provide useful information in the future.

# The Engineering, Marine and Welding Exhibition

No. I

THE nineteenth Engineering, Marine and Welding Exhibition was opened at Olympia on Thursday, September 3rd, by the honorary president, Mr. D. D. Walker. In a brief opening address, Mr. Walker spoke of the growing competition in world markets and the challenge it offered to the British engineering and allied industries. That these industries were prepared to meet the challenge of a competition which they had not experienced until relatively recently in the post war years, was evident from the boldness in design of the plant and equipment to be seen on all sides at the Exhibition. But, said Mr. Walker, a high standard of design and construction was not all that was required to sell goods overseas—there must also be a complementary high standard of salesmanship. For this reason greater attention must be paid to the training and use of skilled technical salesmen who could go out into new markets and make known the latest products of British industry.

At the inaugural luncheon that followed the official opening, Sir James Helmore, permanent secretary, Ministry of Supply, proposed the toast of "Success to the Exhibition." He remarked that the first fruits of the amount of work that had been put into the development of gas turbines could now begin to be seen. It could be hoped that the gas turbine would achieve a success industrially similar to that which it had already achieved in the air. But great research effort was put into other subjects and, though the results might be less spectacular, those researches were just as important. There in the Exhibition one could see the results as the new took the place of the old.

In the following paragraphs we continue the account begun in last week's supplement by describing some of the plant and equipment on show at the Exhibition.

### Williams and James, Ltd.

The air compressors and pneumatic equipment on the stand of Williams and James, Ltd., of Chequers Bridge, Gloucester, includes some of a new range of compressors the firm is making for capacities up to 180 cubic feet per minute.

These compressors are made in units comprising one, two or four cylinders, single stage, and two or four cylinders, two stage. The maximum pressure for the air-cooled, single-stage models is 80 lb per square inch, and for the water-cooled, single-stage models 125 lb per square inch; for the water-cooled, two-stage models it is 450 lb per square inch. The single-stage models cover piston displacements of from 17 to 182 cubic feet per minute, whilst the two-stage models, one of which is shown in Fig. 1, cover piston displacements of from 17 to 90 cubic feet per minute. The maximum speed for all machines is 1000 r.p.m., and the minimum speed is 600 r.p.m., whilst they can all be run in either direction.

A crankcase of cast iron is provided on each side with a large cover plate designed to permit easy inspection and maintenance. Combined with this cover plate is an oil filler which ensures that the maximum level of lubricating oil cannot be exceeded. The cylinder heads and manifolds are of cast iron designed to give a smooth, easy flow and to give effective cooling of the valve assemblies.

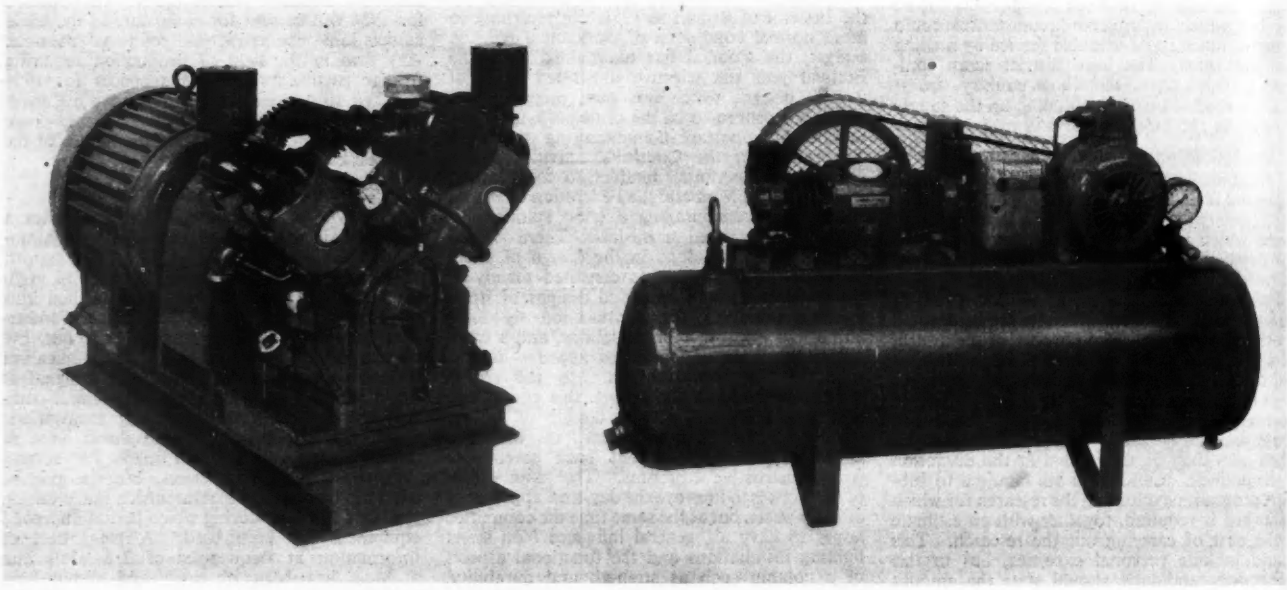
In the single-stage air compressors the cylinders are of high-quality grey iron, whilst for the high-pressure cylinders of the two-stage units high-tensile cast iron is used. A balanced crankshaft of special high-tensile cast iron runs in three white metal-lined, steel-backed, prefinished bearings. The end thrust is taken by separate bronze thrust bearing washers to relieve the main bearings of all but normal journal loads.

A plunger lubricating pump, driven from the end of the crankshaft, delivers oil at 30 lb to 35 lb per square inch to the main bearings, big ends and small ends. Adequate lubrication for the cylinder walls is provided by the oil thrown from the big ends, and overoiling is prevented by the use of a new design of piston and ring pack.

The strip cushion valves are of alloy steel, designed to eliminate shock and overheating and give adequate porting with a minimum clearance volume. An automatic unloader is controlled by the pressure of the lubricating oil. The compressor is unloaded on the delivery side and the unloader is arranged to operate in two stages so that the load is removed and restored gradually to eliminate shock. This unloader can be arranged to suit plants operating under manual or automatic control.

The compressor illustrated in Fig. 2 is of the firm's twin-cylinder "Oil-Free" design with bores of 2½in by 2in stroke. It is suitable for speeds up to 350 r.p.m., at the maximum of which the piston displacement is 3·92 cubic feet per minute. When operating a pressure range of 40 lb to 60 lb per square inch the free air delivery is 2·78 cubic feet per minute. To eliminate need for gudgeon pins, which would require lubrication, the pistons are coupled to the crankshaft of the compressor through yokes and slippers, and special combined bearings and seal housings are incorporated in the crankcase.

On each cylinder the suction and delivery valves are assembled as complete replaceable units to facilitate maintenance. The nickel-cast-iron cylinders have large cooling fins and the bores are honed and lined with a wear-resisting material. The compressor is available as a separate unit or complete with drive and air receiver as illustrated.



Figs. 1 and 2—Two-Stage Compressor and "Oil-Free" Compressor—Williams and James

### British Oxygen Company, Ltd.

The "Argonaut" welding process is being exhibited for the first time by the British Oxygen Company, Ltd., of Bridgewater House, Cleveland Row, London, S.W.1. This process, which was described in The Engineer of April 24th last, can be used for all-position welding on heavy gauge aluminium plate or light alloys, stainless steel or copper. It uses an inert gas shielded arc with a consumable electrode and incor-

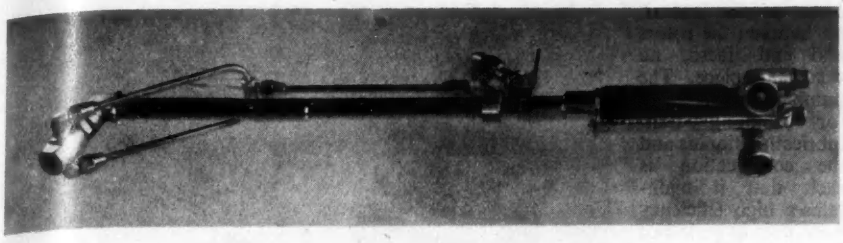


Fig. 3—Powder Cutting Blowpipe—British Oxygen

porates means of automatic regulation.

The company has now introduced an "Argonarc" spot welding equipment for use with bright mild and stainless steel. The torch used with this equipment is illustrated in Fig. 4 and with it welding is effected with access to the top sheet only of an assembly; manual pressure provided by the torch operator is sufficient for fusing the work. It can be used to join thin to thick sections; providing the top sheet of metal is not more than $\frac{1}{16}$in thick it can be spot welded to parts of equal or unequal thickness. The process is also stated to be suitable for tack welding butt joints in thin gauge sheet metal.

The equipment produces a characteristic circular spot weld, and the arc, tungsten electrode and spot area are protected from

Fig. 4—Spot Welder—British Oxygen

the atmosphere by a shroud of argon gas. Automatic operation is provided by an electric timer unit, which can vary the arc time from 0·8 to 5 seconds according to the type and thickness of material and the argon flow valve.

In operation after the current and arc time have been adjusted to suit the work, the torch is pressed by the operator to bring the parts to be joined into intimate contact. Upon the trigger switch being actuated the control switches on, in correct sequence, the gas and cooling water supplies, followed by the high-frequency current and the main welding power. At the end of the preset period all supplies are cut off except the argon, which is allowed to flow until the tungsten electrode has cooled.

The firm is also showing a powder cutting process, which has been developed mainly for the cutting of oxidation resistant metals, such as stainless steel, although non-ferrous metals, such as copper-base alloys and aluminium and its alloys, may to some extent also be cut with this process.

In the powder cutting process finely divided iron powder is used in addition to the normal oxy-acetylene cutting flame, and a stream of iron powder is fed through the blowpipe to assist the oxygen cutting reaction. The powder gives off intense heat during its combustion in the cutting oxygen stream and this combines with the fluxing action of the powder to give effective cutting. The powder is carried to the cutting nozzle in a stream of compressed air, and a dispenser is incorporated in the equipment to enable a properly controlled supply of powder to reach the blowpipe.

This dispenser is a pressure vessel operating at an air pressure of up to 15 lb per square inch and capable of holding a supply of about 100 lb of powder. Powder is carried to the blowpipe (Fig. 3) through a length of flexible tube and thence is taken down around the outside of the cutting nozzle and, passing through inclined ports, is injected through the heating flame into the cutting oxygen stream at a point about an inch below the end of the nozzle.

The maker states that with the present equipment stainless steel can be cut up to 12in in thickness, and that the process has been successfully applied to straight and bevel cutting and to profile cutting. Apart from the dispenser unit and the powder cutting blowpipe, the remainder of the equipment required is similar to that used for normal oxygen cutting, namely, pressure regulators for acetylene, cutting and preheat oxygen, and lengths of rubber hose for the acetylene and oxygen supplies. The "Cutogen 6" powder cutting blowpipe is basically similar in construction to the well-known "Cutogen 5" general blowpipe hand cutter.

Demonstrations are being given on a 55in universal cutting machine and a 36in universal cutting machine, both using the one-piece nozzles. Each of these profile cutting machines is adaptable for powder cutting, which makes possible the profiling of stainless steel. Other equipment on show includes a complete range of ancillary equipment and welding materials for all kinds of fabrication and repair work.

### The David Brown Companies

On their stand the David Brown Companies, Huddersfield, show examples of the products from the foundry, gear and tractor divisions of the organisation. A fully machined half-turbine case steel casting weighing about 6·5 tons illustrates foundry capacity and technique; also exhibited in this section are a number of precision castings made by the investment process, bronze castings produced by sand, and centrifugal processes, and some centrifugally cast heat-resisting units for gas turbines.

Two railcar gearboxes are on view and both of these hypoid gear units are displayed in sectional form, the larger unit, shown in Fig. 6, and designed for input powers from 1·25 h.p. to 5 h.p., being an example of the equipment supplied for a Canadian fleet of high-speed subway cars. Representative of the tractor division is a David Brown standard marine diesel engine, which can be seen in our photograph, Fig. 5. This is a four-cylinder, four-stroke, power unit which develops a maximum of 32·5 b.h.p. at 1800 r.p.m., and has a continuous rating of 26·5 b.h.p. at 1600 r.p.m. The bore and stroke are $3\frac{3}{8}$in and 4in respectively, and the compression ratio is 16 to 1. The cylinder block and crankcase are chrome alloy castings fitted with high-grade cast iron wet liners, and there is a cast iron sump of 3 gallons capacity. Chrome alloy cast iron is used for the cylinder head, which has replaceable valve seat inserts, copper injection sleeves and tangential inlet ports, while the

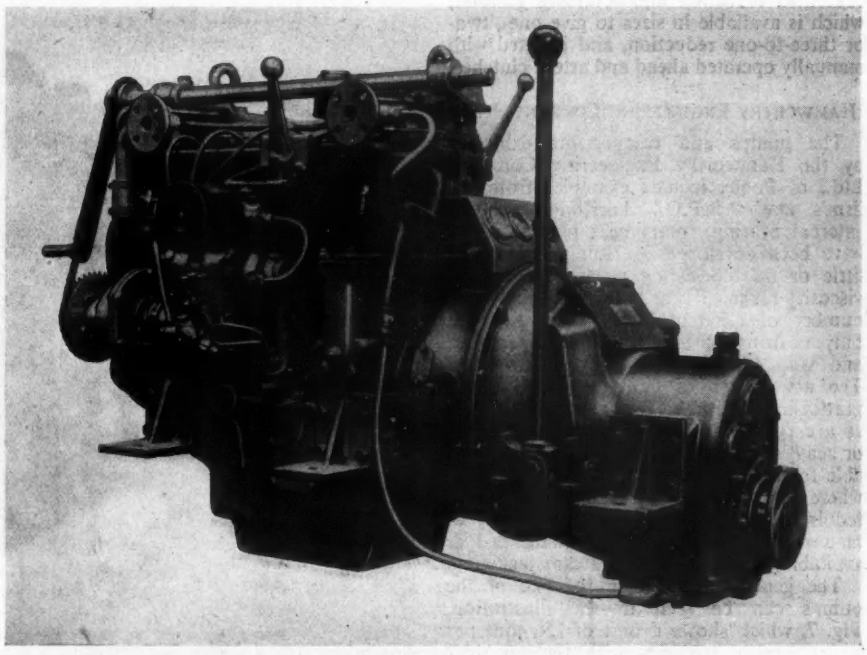


Fig. 5—Marine Diesel Engine—David Brown

poppet valves are of silicon chrome steel and operated by rockers and push rods.

Each piston, which is a silicon alloy casting, has one plain and two stepped compression rings above the gudgeon pin, and one scraper ring below, while the "H" section, drop forged, manganese-molybdenum-steel connecting-rod has a phosphor-bronze small-end bearing and a steel backed copper-lead big-end bearing. The nickel-chrome

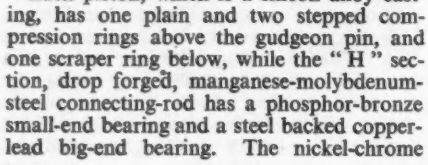


Fig. 6—Hypoid Gear Unit—David Brown

forged crankshaft has "Tocco" hardened main and big-end bearings and is carried in three main bearings (with the centre bearing arranged to take end thrust), of which the bottom half is of copper-lead, steel backed, and the upper half is of white metal, steel backed.

The fuel supply is by direct injection and the equipment includes a C.A.V. injection pump with pneumatic governor and mechanical lift pump. A C.A.V. vacuum pattern governor is fitted and operates over the whole of the speed range. A submerged gear pump supplies lubricating oil under pressure to the bearings and intermittent pressure feed to the valve gear and the system includes a pressure relief valve which opens at 40 lb per square inch. The open circuit cooling system is maintained by a gear pump, the temperature of the cylinder head and block being thermostatically controlled. The final drive is through a heavy-duty combined reduction and reversing gearbox, which is available in sizes to give one-, two- or three-to-one reduction, and is fitted with manually operated ahead and astern clutches.

### Hamworthy Engineering Company, Ltd.

The pumps and compressors exhibited by the Hamworthy Engineering Company Ltd., of Poole, include examples from the firm's new "R.P.O." horizontal spindle, external bearing, rotary gear pumps, which have been developed to handle fluids with little or no lubricating value with a wide viscosity range. These pumps are made in a number of different sizes having nominal outputs from 2·5 tons to 600 tons per hour and with branch sizes from 1in to 12in. The new design of pump is stated to be particularly suitable for marine purposes as a cargo pump for petrol, gas, diesel oil, or heavy furnace oils, and it is equally adaptable for the chemical and process industries where a positive displacement pump is required. It can be supplied in a variety of materials to suit different liquids and is available with and without steam jacketing.

The general arrangement of one of the pumps can be seen in the illustration, Fig. 7, which shows a unit of 150 tons per hour nominal capacity with the top half casings removed. As there is no contact in the pumping chamber either between the teeth of the rotors, or between the rotors and end faces, no wear takes place. The pump is thus suitable for handling non-lubricating liquids and the construction is such that it maintains a high efficiency over a long period of time with little call for maintenance. Standard pumps are designed for a maximum discharge pressure of 100 lb per square inch and can handle fluids of the viscosity of petrol up to 2000 secs. Redwood No. 1 at the maximum operating speeds. Running at lower speeds they are claimed to be capable of handling any fluid which can be made to flow through a pipe, and the design can be adapted for higher working pressures up to 200 lb per square inch if required.

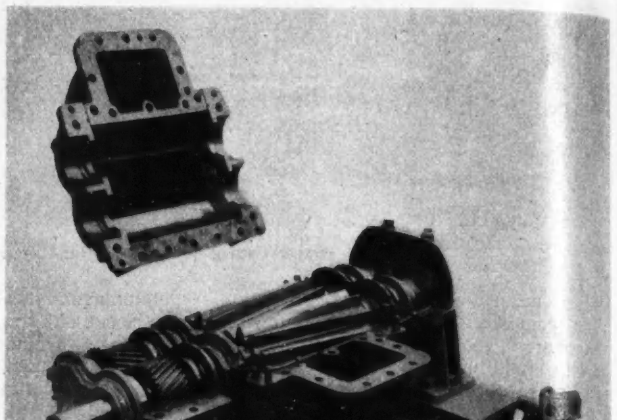


Fig. 7—Split Casing Rotary Pump—Hamworthy

A base-plate of fabricated steel or cast iron, forming a rigid attachment between the pump unit and driving motor, carries the suction and delivery branches and takes the weight of any unsupported pipe work to eliminate the possibility of distortion and malalignment of the pump unit from this source. Where the driving unit is remote from the pump, as it might be in a cargo oil pump where the drive is taken through the bulkhead adjoining the pump compartment, there is fitted a short underbase only, which is of sufficient length to accommodate the pump unit and bearing housings.

The suction and delivery connections between the base-plate and the pump unit form the pump seating on which the unit is located by means of dowel pins. The separate bearing housings at each end of the pump unit are also bolted to machined faces on the top of the base-plate and located by means of dowel pins. The bearing housing at the driving end of the pump houses the timing gears, which transmit the drive between the driving and the driven shafts. As can be seen in Fig. 7, the pump casing and gland housings are split in the plane of

Fig. 8—Steam Jacketed Rotary Pump—Hamworthy

the rotors and spindle centre lines. The top and bottom halves are located by means of fitted bolts, the metal-to-metal joint being surface ground and hand scraped prior to machining the rotor bores. The timing gearcase and bearing housing are also split on the horizontal centre line, the halves being located by fitted bolts.

The pump rotors, of single or double helical construction, give an even discharge with the minimum of pulsations and can be manufactured in bronze, high duty alloy iron, case-hardened steel or stainless steel as may be required. These rotors are generally shrunk on to alloy or stainless steel spindles which are ground on all wearing surfaces, although in certain cases they are forged integral with the shafts. Each spindle is carried on four self-aligning ball or spherical roller bearings, one bearing at the free end being located axially in the housing and on the shaft to provide the requisite axial clearances and absorb any unbalanced axial load between the opposed single helical pump rotors and timing gears. These timing gears have ground tooth profiles and are located between the two bearings at the driving end of the pump.

The pumps are fitted with mechanical seals or conventional packed stuffing-boxes as required. If stuffiing-boxes are preferred, arrangements can be made to supply sealing oil or fluid to a lantern ring in the centre of the box at a pressure above that in the pump suction. Each gland, whether of the mechanical seal or conventional type, is subjected to suction pressure only. A spring-loaded dashpot high-lift by-pass valve housed in the base-plate protects the pump motor and pipeline equipment against overload.

In pumps of this design fitted with steam jackets the body is mounted between and supported by the bearing housings at each end. In turn the bearing housings are supported on the base-plate at approximately the centre line of the rotors to minimise the effects of expansion at high temperature. As with the standard type of pump, the bearing housings are split on the centre line to facilitate inspection and dismantling.

In larger sizes of pumps the body is mounted independently of the bearing housings, but again the point of support is approximately at the centre line of the rotors. In addition the body is keyed axially and transversely to the bed-plate to permit free expansion in operation. These larger sizes of pumps are suitable for handling fluids up to 400 deg. Fah. with jacket steam temperature up to 500 deg. Fah.

In Fig. 8 we illustrate one of the larger pumps fitted with a steam jacket, and complete with an air-cooled pressure lubricating system. In this machine a fan, which is belt driven from an extension of one of the rotor shafts, draws cooling air through the lubricating oil radiator to be seen at the end of the pump base. A spring-loaded relief valve unit is mounted in a convenient position on top of the housing in this pump.

### Alfa-Laval Company, Ltd.

One of the major exhibits of the Alfa-Laval Company, Ltd., Great West Road, Brentford, is a centrifugal separator designed specifically for the purification of turbine lubricating oil. The capacity of these units, which depends, like all centrifuges, on the fluid conditions and viscosity, ranges from a maximum of 800 gallons per hour for the largest unit, the "B1729," which is suitable for turbine lubrication systems of 4800 to 8000 gallons, to a minimum of 30 gallons per hour for systems of 180/300 gallons. The bowl is of the de Laval disc pattern, in which the separating efficiency is very greatly increased by using a pack of conical discs in the separating zone. This design allows a constant efficiency and, hence, throughput, to be obtained, and it is claimed that under favourable conditions it is possible to reduce the water content to 0·02 per cent. Special anti-flood equipment has been included in the unit in order to ensure that no oil can be lost due to evaporation of the water seal after long periods of running or mis-operation. To lower the

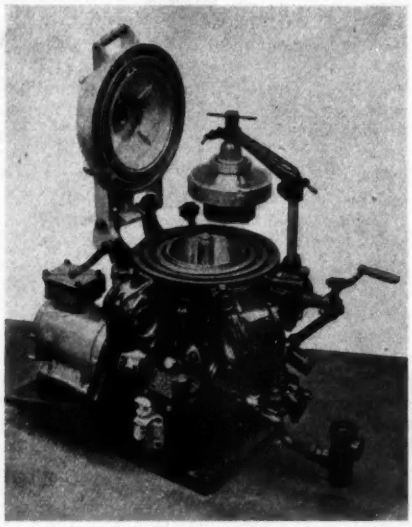


Fig. 9—Centrifugal Oil Purifier—Alfa Laval

viscosity of the fluid in order to reduce its resistance to solid displacement and the tendency to emulsify, the oil is heated indirectly using water at atmospheric pressure, which ensures that the risk of carbonising is entirely eliminated.

Our illustration, Fig. 9, is typical of the standard oil purifier used for other oils such as diesel fuel and lubricating oil, insulating oil, cutting oil, rolling mill lubricating oil, paraffin, &c.

It embodies totally-enclosed aluminium alloy covers, hinged to the frame, giving easy access to the bowl. All piping connections are made to the bottom stationary part of the purifier casing so that no joints have to be broken when the covers are swung back. The purifier bowl is similar in principle to that mentioned above, but can be arranged for purification, clarification or positive washing.

The bowl is also self-draining so that the liquid contents are automatically discharged when the bowl comes to rest, leaving the solid in a comparatively dry and easily removable condition. Special sight flow indicators are incorporated in the oil and water discharge ports, so that both these discharges are easily observed from one position.

A "davit" bowl lifting gear is fitted, which facilitates removal of the internal parts of the bowl. The drive is direct from an electric motor through an automatic centrifugal friction clutch which ensures smooth acceleration and reduces the starting current to a minimum.

Other exhibits also include machines with nozzle and self-opening bowls and a desludger in which the solids are continuously discharged.

### British Aluminium Company, Ltd.

Most of the exhibits on the stand of the British Aluminium Company, Ltd., London, S.W.1, are intended to demonstrate the application of the aluminium alloys to marine purposes and particularly the development of the arc welding of aluminium by the argon arc and "Argonaut" processes. The main item is an all-welded deckhouse measuring approximately 38ft wide by 21ft long, which will be fitted eventually on the Clan Line cargo ship "Clan Robertson," at present under construction at the yard of the Greenock Dockyard Company, Ltd.

Non-heat-treatable aluminium-magnesium alloys have been used to standard specification NP 5/6 for the plate material and to NE 6 for the extruded sections. For the radiused front of the deckhouse, plating 0·30in thick has been employed, while the side plating is 0·27in thick and all the stiffeners are 4in by 1½in tee bars, which are placed toe on and have been specially designed for welded construction. The plating is arranged vertically with butt welds at the stiffeners. Part of the deck over is included and this consists of 0·25in thick plating laid on 5½in by 2¾in special section tee beams.

A wall panel shows a full-size midship

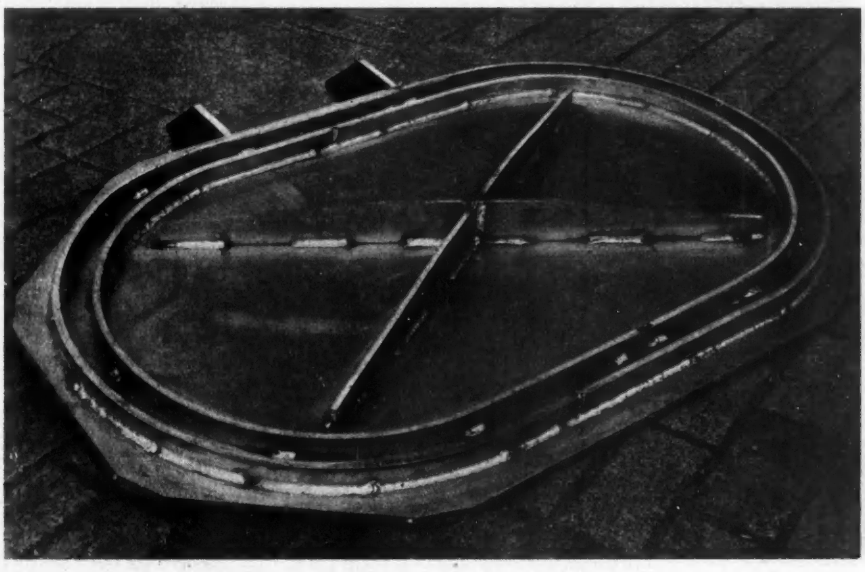


Fig. 10—Hatch Cover for Oil Tanker—British Aluminium

section of the 72ft all-welded auxiliary motor yacht "Morag Mhor," which has been designed by Laurent Giles and Partners, Ltd., and is being built for the company by Saunders-Roe (Anglesey), Ltd. One-half of the section is built in aluminium alloy plate and sections, and the other is a drawing giving constructional details. On the other side of the wall panel the details of an all-welded, longitudinally framed barge are shown in a similar manner. The barge represented is 85ft long by 21ft beam by 9ft moulded depth, and is plated with 0·25in thick material and the longitudinal frames are 6in by 3in tee bars used in conjunction with flanged plate transverse web frames placed about 6ft apart.

A number of argon arc welded ship fittings are also on view; they include cowl and mushroom ventilators, tanks for ships' lifeboats, a hatch cover for a cargo lighter, a hatch cover for an oil tanker, which we illustrate in Fig. 10, and a dinghy. Another display shows the use of aluminium alloy sheet for ships' awnings and there are examples of stanchions cast in "L.M.6" material, and a shaft bracket cast in an alloy to standard specification "L.M.10." Among the non-marine exhibits are a dumper bucket fabricated by Head, Wrightson Aluminium, Ltd., and a model of the bridge being built by the latter company to the design of the harbour engineer of the Aberdeen Corporation.

### Rotol, Ltd.

Examples of controllable-pitch marine propellers and ancillary equipment are shown by Rotol, Ltd., Gloucester, and among the exhibits are the hub, blade, bearing and operating pin, components of a 12ft diameter propeller suitable for installation in tugs and colliers. A typical 36in controllable-pitch propeller as used for high-speed launches is shown in sectioned form to reveal the internal pitch changing mechanism, which consists essentially of a hydraulically operated piston linked to the blades in hub sockets where the linear movement of the piston is converted into rotary movement of the blades. A working model of the same size of propeller, which can be seen in Fig. 11, demonstrates how lever operation is quickly and accurately converted into change of pitch of the propeller blade, the rate of change being at 10 deg. per second and the range of pitch available being 110 deg.—that is, from 90 deg. ahead to 20 deg. astern.

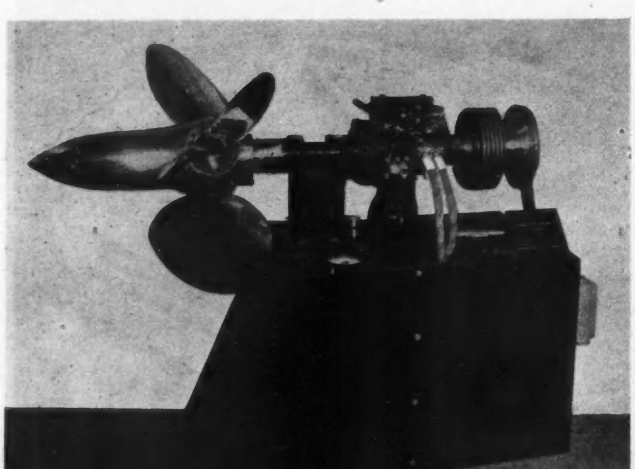


Fig. 11—Propeller Working Model—Rotol

On the stand is a constant-speed unit, which we illustrate in Fig. 12 and which contains spring load flyweights sensitive to changes in engine revolutions. In response to any such change the flyweights actuate a selector valve which admits pressure oil to the pitch changing mechanism to either coarsen or fine the blade pitch as required. A movement of the control lever alters the

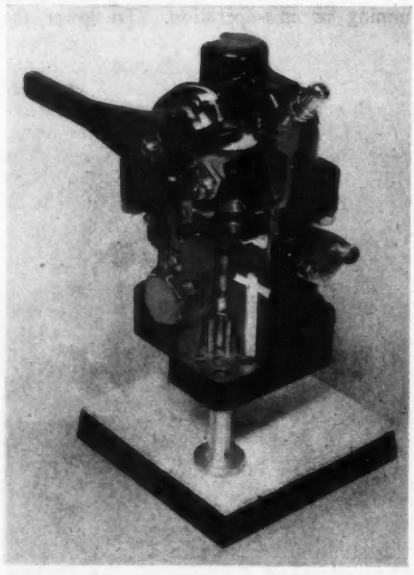


Fig. 12—Constant-Speed Propeller Unit—Rotol

governed revolutions per minute and also adjusts the loading on the flyweight spring. The engine can be governed from full power ahead down to a predetermined level at which the governing mechanism becomes inoperative and the selector valve is then manually controlled. Another exhibit is the automatic engine revolutions per minute synchronising equipment, which eliminates "beat" vibration set up by two or more engines running out of synchronism.

### Bryce Berger, Ltd.

Bryce Berger, Ltd., of Ironbarks Works, Staines, Middlesex, is showing a representative range of the company's products and a number of new items of equipment, including two examples of the "B" size camshaft fuel injection pump, namely, a six-cylinder unit with centrifugal governor and a four-cylinder unit without governor. The pump has been designed to provide a robust and simple unit for multi-cylinder engines requiring a single enclosed pump with integral camshaft instead of individual pumps for each cylinder. Two, three, four and six-cylinder units are available, one of which is shown in the illustration, Fig. 13, and the accompanying line drawing, Fig. 14. The plunger has a stroke of 10mm and a diameter ranging from 6mm to 11mm, which is suitable for engines requiring full-load fuel up to 250 cubic millimetres per stroke. Control is by right or left-hand rack operation and the cam has a lift of 10mm with a rate of 0·3mm per cam degree. Provision is made for mounting a centrifugal governor on either end of the pump.

These pumps operate on the constant-stroke, variable-spill principle, utilising a helix, machined on the plunger head so as to give the required spill control and to permit unrestricted passage of the fuel while providing the maximum bearing surface to the pump plunger. A monobloc aluminium alloy casting forms the housing, which has a large front opening and a cover plate, carrying the air filter and breather, having an upward extension to seal the heads of the sleeve locating screws. Roller bearings carry the camshaft, which has a diameter of sufficient size to avoid deflection and eliminate vibration. Dowel screws passing through the pump housing locate the roller tappets, which can be adjusted for pump phasing by fine-pitch screws and locknuts, while pump calibration to ensure that an equal amount of fuel is delivered to each cylinder is effected by a slotted pinion and socket head screw.

Conventional mitre-faced delivery valves having an unloading collar in the shank above the fluted guide portion are fitted, the entry of the collar into the valve seat bore

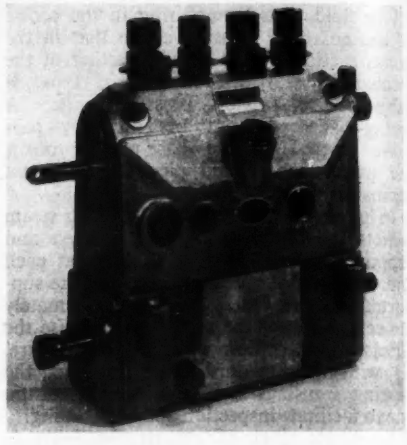


Fig. 13—Camshaft Fuel Injection Pump—Bryce Berger

causing an increase in delivery pipe volume and assisting in rapid nozzle needle closure. Locking plates at the discharge unions ensure that the controlled torque, to which these are tightened, is not disturbed when fitting high-pressure pipes from pumps to injectors. Lubrication is by fuel oil and provision is made for mounting a fuel feed pump on the front of the housing and an eccentric drive for this is provided on the camshaft.

Several new items which are now available in the Berger starters are on view, including a piston accumulator, an automatic charging pump, a unit with front power take-off and a plunger pressure gauge.

For starting in extremely low temperatures the piston accumulator has been developed and, with it, the Berger hydraulic starter system is now suitable for operation at —40 deg. Fah. (—40 deg. Cent.), and will store at lower temperatures. The accumulator consists of a cylinder, having a honed bore, containing a free piston with a special spring-loaded seal, which is self-adjusting and automatically compensates for any wear on its sealing face and which maintains a seal between the compressed air on one side of the piston and the oil on the other. Each end of the cylinder is enclosed by a cap, that at the air end containing a non-

return valve, to permit the entry of the initial air charge, and that at the oil end embodying a self-sealing joint. The unit, which can be mounted in any position, is fitted with a manually operated control valve, and has a capacity of 1500 cubic centimetres, while at the normal operating pressure of 4250 lb per square inch (290 atmospheres) it will provide one start per charge with a "B.50" starter and three starts with a "B.35" starter.

The automatic charging pump is engine driven and as soon as the engine starts the pump recharges the accumulator. At 1000 r.p.m. it will charge a single accumulator in about four minutes, and the pump, which

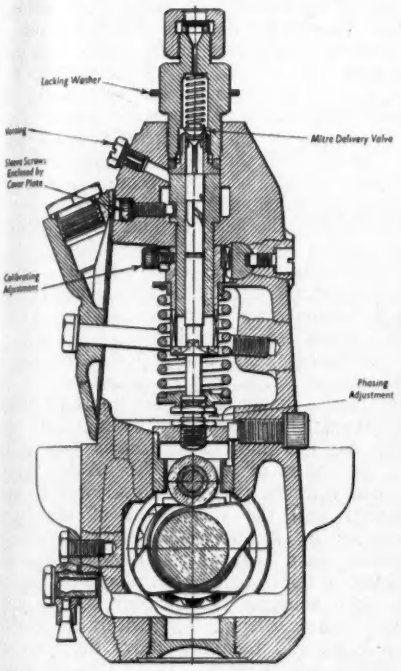



Fig. 14—Fuel Injection Pump—Bryce Berger

is automatic and self-lubricating, may be driven continuously in either direction at between 200 and 1800 r.p.m. There are two main assemblies, the top half containing the pumping unit, with delivery valve and port controlled inlet valve, the lower half consisting of the cam-box housing an eccentric shaft supported on ball bearings. Direct shaft or belt drive can be used and the torque requirement is 2 lb-ft, or 0·4 h.p. at 1000 r.p.m. The pumping stroke is spring controlled, the eccentric shaft serving to return the pump plunger on the inlet stroke, delivery being automatically cut off at 4250 lb per square inch when the accumulator is fully charged.

The Berger starter is generally applied to the free end of the crankshaft, and to meet requirements for driving auxiliary components a power take-off arrangement has been devised. The equipment consists of a "B.50" unit with a special centre housing having an extension to carry a ball bearing and support a pulley or drive hub having a splined bore. An alloy steel shaft, with splines at each end and capable of transmitting a torque of 450 lb-ft, passes through the centre of the starter housing, one end entering the splined bore of the drive hub and the other engaging the splined bore of the engine dog adapter.

The plunger-operated pressure gauge is suitable for recording pressures between 1500 lb and 5000 lb per square inch, and consists of a tubular housing containing a cylinder and piston assembly to which hydraulic pressure is admitted. The pressure is indicated on a graduated extension of the piston, which acts against a spring.

Other exhibits to be seen on the stand include an "HL-T" nozzle, which has been developed for the larger high-speed engines, and hydraulic governors for the "A.S.R.I." and Napier "Deltic" engines; for the latter engine the unit is a fully hydraulic servo governor covering an engine speed range of 500 to 2000 r.p.m. and embodying torque limitation and hand over-ride control.

### Saml. Denison and Son, Ltd.

Most of the testing machines displayed upon the stand occupied by Saml. Denison and Son, Ltd., of Leeds, have already been described in the columns of The Engineer; they include universal, tensile and high temperature creep testers for metals, concrete testing machines and fabric testing machines. A piece of equipment made by this firm not dealt with before, however, is its suspended weighing machine; the example exhibited is a 2 tons capacity steel-yard weigher. These steel-yard machines are made in capacities of 2 tons to 10 tons and similar units are also available with dial indicators. The makers state that these weighers are very sensitive and accurate and are now being used in the aircraft industry for centre-of-gravity testing.

The weighers have strong steel frames and substantial levers to withstand rough usage. They are fitted with a compound weighing lever system incorporating hardened knife-edges and self-aligning bearings. A roller bearing bottom hook and a top hook loop are fitted.

### Ruston and Hornsby, Ltd.

The diesel engines exhibited by Ruston and Hornsby, Ltd., Lincoln, are displayed in association with Davey, Paxman and Co., Ltd., but in the annexe adjoining the Grand Hall the company has installed one of its "Mark T.A." gas turbines which are now being batch produced. With the co-operation of the various authorities the turbine is supplying electricity for a proportion of the lighting of the exhibition. For this purpose the unit is running on load for ten hours per day during the duration of the exhibition and is supplying power to the Olympia substation at 6600V, where it is transformed to 230V and 400V to suit lighting and power requirements. The turbine can be inspected during the daily running demonstrations, but the requirements of the exhibition preclude the possibility of showing the flexibility of control and the starting arrangements.

The machine installed is of non-recuperative design and as such is conservatively rated at 900kW, while the rating is 750kW when running with its heat exchanger. This unit is a lightweight adaptable industrial turbine of long-life design and has a combustion chamber developed to burn a wide variety of fuels, including diesel oil, natural gas and coal tar. Structurally the "T.A." turbine consists of two units—the compressor and associated turbine and the power turbine and gearbox unit. Each unit is located relatively to the other through short internal structural paths and not through the bedplate, so that uneven supports will not cause damage. Our illustration (Fig 15) shows a non-recuperative "T.A." turbine in which the combustion chamber is mounted alongside the compressor casing, the compressor being of thirteen-stage axial-flow design. A high-tensile steel bolt secures each turbine to its shaft, thus permitting a single-piece connecting duct between the turbines. Double-skinned cooled construction is incorporated and cooling air is bled from the compressor at three points so that the lowest pressure necessary to circulate the air is used for each air feed and the minimum of power is lost. A Stoechicht epicyclic reduction gear manufactured by W. H. Allen, Sons and Co. is employed, the drive being taken from the power turbine through a welded tubular shaft and flexible muff coupling to a B.T.H. 6600V, three-phase, 50 c/s alternator having a maximum rating of 1250kVA at 1500 r.p.m.

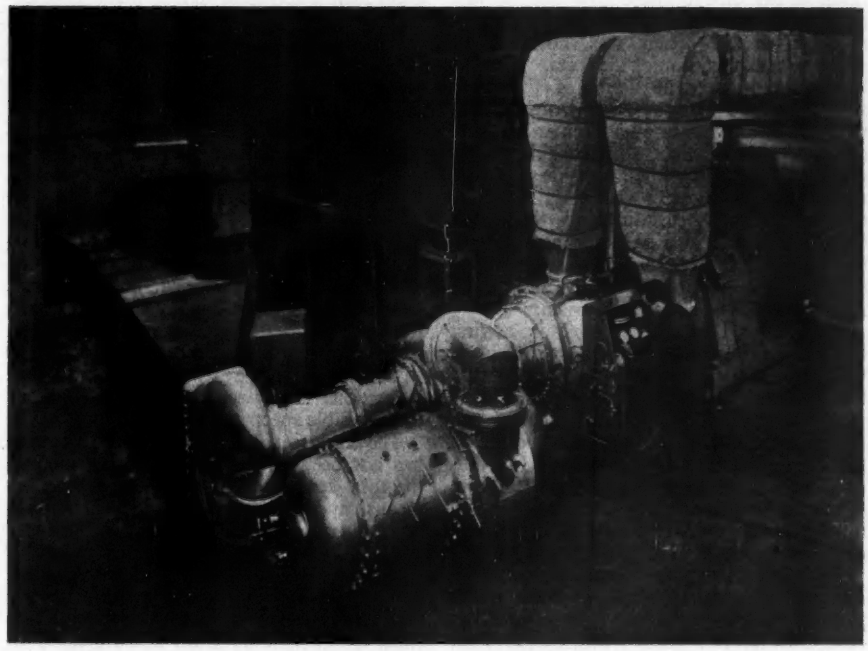


Fig. 15—Gas Turbine Generator Supplying Power to the Exhibition—Ruston and Hornsby

*(To be continued)*

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The London Midland Region of British Railways announces the appointment of Mr. A. I. Macmillan as assistant (works maintenance), in the civil engineer's office, Euston.

# A Short History of Spectroscopy

By T. W. CHALMERS, D.Sc., M.I.Mech.E.

## No. VI—LIMITS OF TRANSPARENCY

(*Continued from page 291, Sept. 4th*)

IN 1800, as already recorded, Herschel discovered that the solar spectrum produced by a glass prism extended beyond the red end into an invisible region which could be detected by means of a sensitive thermometer. In 1801, Ritter made the complementary discovery that beyond the violet end there was also an invisible extension which was revealed by the blackening effect exercised on paper coated with silver chloride.

The natural question at once arose: to what length did the solar spectrum extend in each invisible region? Trials with a glass prism showed that there was apparently a limit to the spectrum at either end. There was a point in the infra-red beyond which no heating effect could be detected; there was a point in the ultra-violet beyond which the photographic effect disappeared.

It therefore seemed reasonable to conclude that the solar spectrum covered a finite range of wavelengths and that outside this range, at either end, there was no kind of radiation at all. There was, however, an alternative explanation of the facts. It might be that the apparent limits of the solar spectrum were set not by a restriction in the range of wavelengths emitted by the sun, but by a restriction in the ability of a glass prism to detect them outside a certain range. It was possible that glass might be transparent to a certain range of wavelengths and that outside this range at both the high and the low end it was opaque to infra-red or ultra-violet radiation and, therefore, incapable of acting as a prism.

Unlikely as this supposition must at first have seemed, practical confirmation of it was soon forthcoming. It was found that the apparent limits of the solar spectrum were placed by different kinds of glass, such as crown and flint, at different points in the infra-red and the ultra-violet. In addition, prisms of rock salt or quartz were found to reveal at both ends wavelengths in the solar spectrum outside the range disclosed by any kind of glass prism.

The inference could not be ignored. Different materials differed in their transparency to light radiation. A body normally described as transparent transmitted light radiation of wavelengths lying between an upper and a lower limit. Outside this range of wavelengths, which differed for different materials, the body was opaque. There was, therefore, no reason to suppose that the solar spectrum was confined to any precise limits. The apparent limits indicated by practical experiment were fictitious. They were produced not by absolute limits to the extent of the spectrum, but by limitations resident in the experimental equipment.

With this widened horizon before them spectroscopists began a search, which has hardly yet been completed, for new means of probing ever further into the ultra-violet and infra-red regions of the spectrum. The picture as it emerges to-day shows us the ultra-violet region extending down without a break into the field of X-rays and the $\gamma$-rays emitted by radio-active substances. At the other end the infra-red region has been carried forwards until it now joins on to the field of "wireless" waves. Defining "light" in its broadest sense as an electro-magnetic vibratory disturbance we can now say that the electro-magnetic spectrum covers wavelengths ranging, in the $\gamma$-ray field, from a very minute fraction of a millimetre to many thousands of metres in the radio field. Of this vast range the portion covering visible light is a very small part.

Different portions of the total spectrum differ solely as regards their wavelengths. They appear different to us because they affect our senses differently and require different methods for their detection. But that they are fundamentally similar is shown by the fact that their detectable effects reveal an unmistakable continuity. Thus, at the lower end the photographic action of the violet and ultra-violet rays is increased as we pass into the field of X-rays and is still further augmented when we reach the field of $\gamma$-rays. As we pass upwards from the violet rays the photographic action becomes less and less. Just beyond the red end of the visible spectrum it disappears and a growing effect manifested to us as heat takes its place. This heating effect is carried on across the ill-defined point at which the long infra-red rays pass into the short radio waves. The continuity in this region is demonstrated in a practical manner by the fact that short radio waves are now being used on a commercial basis in heating and drying processes.

The general problem which spectroscopists have had to face can now be defined. It has consisted of devising experimental means whereby rays invisible to the human eye can be made to give indications which are capable of being recorded and measured. In effect the problem has involved the search for means whereby the invisible rays can in some way be rendered visible; in other words, whereby they can be made to give indications falling within the narrow limits of the visible spectrum*.

The task set before the spectroscopists has not been an easy one. Each region of the total spectrum has had to be studied by means appropriate to it. The complete account reveals a tale of great ingenuity in the overcoming of natural obstacles, combined in places, we cannot help thinking, with a remarkable degree of good fortune.

For the study of the visible region of the spectrum, extending from a wavelength of about 0·4 micron in the violet to about 0·8 micron in the red refracting prisms and transmission gratings provide the solutions to the spectroscopist's problem. When however, he goes outside these limits he is faced with two difficulties. In the first place the rays are invisible to his eye and, secondly, all the materials which he can use for making his prisms—or transmission gratings—lose their transparency, or cease to be sufficiently transparent, when the wavelength falls below a certain lower limit or exceeds a certain upper limit.

In the ultra-violet region photography supplies the solution to the first of these difficulties because photographic plates and films can "see" and record wavelengths which are too short to affect the optic nerve directly. Passing in the opposite direction, towards and into the infra-red region, the spectroscopist finds the application of photography restricted by the fact that there is an upper limit to the photo-actinic sensitivity of silver salts. The use of a ruby lamp in a photographer's "dark room" implies that this limit of sensitivity lies short of the red end of the visible spectrum. To-day this implication is not strictly correct. By means of special dyes photographic plates and films sensitive to infra-red radiation of wavelengths up to about 1·2 microns have become available.

Hence, as a means of obtaining a visible record of the total spectrum photography is applicable over a range of wavelengths extending from far into the ultra-violet to a short distance into the infra-red. A point of some importance should here be noted. Photographic gelatine has a lower limit of transparency at about 0·18 micron. That wavelength lies well within the ultra-violet but is still very much greater than the wavelengths of X-rays. Nevertheless, X-rays, as is well known, are very active in their effect on a photographic plate. The explanation of this apparent anomaly lies in the fact that the grains of silver chloride or bromide with which the gelatine is impregnated are distributed at random within the thickness of the gelatine film. Some lie on its surface and are therefore open to the actinic effect of the rays. These surface grains are not shielded by the opacity of the gelatine and when the plate is developed it is they which provide the record of the rays.

To increase the actinic action of the rays a fluorescent screen may be placed on top of the plate. Many substances fluoresce when bombarded by X-rays. The fact that we can see the fluorescence shows that it is in the nature of visible light. A law associated with the name of Sir George Stokes asserts that the wavelength of the light emitted by a fluorescing body is always greater than that of the rays exciting it. Hence, a fluorescent screen placed on top of a plate converts the incident X-rays into light of a wavelength lying within the visible spectrum and therefore above the limit of gelatine transparency. This light can penetrate the gelatine and exercise its actinic effect on the silver grains lying more deeply than on the mere surface of the sensitised layer.

With photography inapplicable as a means of rendering visible rays exceeding about 1·2 microns in length other means of studying the infra-red region have to be applied. These means consist in every case of using a very sensitive temperature measuring device to investigate the heating effect of the rays and of arranging it in such a way as to cause its electrical or other form of response to produce a visible record.

This brings us to the second difficulty which the spectroscopist has had to overcome, the restriction in the transparency of all known materials to radiation below or above certain limiting wavelengths. This restriction affects the employment of prisms, transmission gratings, lenses and all other parts of the experimental equipment which call for the transmission of radiation through them.

The limits of transmission or "transmittance" of glass vary with its exact composition. Roughly, however, the lower limit lies at about 0·35 micron or a little below the wavelength of the violet end of the visiible spectrum. Its upper limit may be placed at about 3 microns in the infra-red.

It should be noted that the onset of opacity at either end of the range of transmission is in general gradual rather than sudden. The limits of transmission of a substance are therefore not precise points. A common convention defines transmittance by the ratio $I/I_0$, where $I_0$ is the intensity of

* All physical measurements necessarily depend ultimately upon the visual observation of some length or angle. Simple examples are the measurement of temperature by the length of a mercury thread or the deflection of a spot of light, the measurement of time by the angular displacement of the hands of a watch and the measurement of mass by the extension of a spring.

the incident radiation entering a substance and $I$ is the intensity of the radiation after it has passed through the substance. The value of this ratio naturally depends upon the thickness of the substance in the direction of transmission. Frequently the thickness chosen is 3mm, but in some cases it is taken at 2mm and in others at 10mm.

The limits of transmission of a substance are regarded as being marked by those wavelengths at which the value of the ratio $I/I_0$ falls below an arbitrarily fixed value usually 50 per cent. In Fig. 24 there is shown the

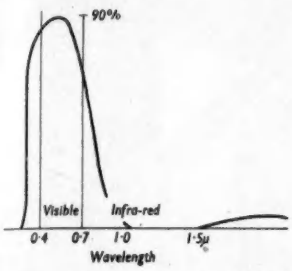



**Fig. 24—Transmittance Curve of "ON20" Glass**

transmittance curve for a 3mm thick piece of Chance Brothers "ON 20" glass. It will be noted that at one wavelength within the visible spectrum this glass transmits 90 per cent of the light of that wavelength incident upon it. In the ultra-violet region the transmission decreases very rapidly, complete opacity being indicated as occurring at about 0·3 micron. In the infra-red region the decrease of transparency is less rapid, complete opacity being shown as occurring at about 1·0 micron. The curve shows, however, that the opacity at 1·0 micron is replaced by a low degree of transparency when the wavelength is lengthened to about 1·5 microns. Many other materials show a corresponding decay and recovery of transparency and this fact, as we shall see presently, has been usefully applied by spectroscopists.

The limits of transparency of rock salt are wider than those of glass. They run from about 0·18 micron in the ultra-violet to about 15 microns in the infra-red. Rock salt does not lend itself to the production of a transmission grating, but in spite of its hygroscopic nature it can be formed into prisms and lenses. The early use of rock salt in these forms by Melloni has already been noted. In 1886 Langley, using his newly invented bolometer and employing prisms and lenses of rock salt, detected in the infra-red region of the solar spectrum wavelengths up to about 5·5 microns.

Fluorite (calcium fluoride) has a lower limit of transparency of about 0·12 micron and an upper limit of 9 microns or a little more. Fluorite therefore excels rock salt in transparency within the ultra-violet region, but falls short of it in the infra-red. In 1893 Schumann, using a fluorite prism in a vacuum and employing special photographic plates, succeeded in recording wavelengths close to the lower limit of fluorite transparency. At the opposite end Paschen in 1894, using a fluorite prism and his improved form of radio micrometer, obtained a record of wavelengths in the infra-red region close to the upper limit of fluorite transparency.

Sylvite, or sylvine (potassium chloride), provided the means of making a further step. It is inferior to fluorite in its transparency in the ultra-violet, but is superior to it in the infra-red, its upper limit being at about 23 microns. In 1897 Rubens and Trowbridge, using a sylvite prism, detected infra-red rays of wavelength close to the upper limit of sylvite transparency.

Subsequently potassium bromide was found to be even more transparent to infra-red radiation than sylvite. With it wavelengths as long as about 28 microns have been recorded.

The lower limit of fluorite transparency (about 0·12 micron) and the upper limit of potassium bromide transparency (about 28 microns) may be taken as marking the range of wavelengths which can be studied by means of refracting prisms. Outside that range methods other than the use of prisms have to be employed. Even within the range all is not plain sailing. If the radiation from the source is transmitted to the prism through air account must be taken of the fact that air itself possesses limits to its transparency which will naturally be superimposed on the limits of the prism material.

The lower limit of air transparency is at about 0·18 micron. If pure, it remains transparent far into the infra-red. If, however, it contains any water vapour or carbon dioxide its transparency becomes complicated. Air so contaminated shows opacity or semi-opacity over a number of separated bands of wavelength. The complexity thus introduced can in practice be avoided by operating the whole spectrometer equipment —including the source of radiation—in a vacuum or in an atmosphere of nitrogen, argon, hydrogen, &c., at low pressure.

This procedure is, however, impracticable to solar radiation, which must of necessity pass through the earth's atmosphere before reaching us. The difficulty here involved has been overcome indirectly by observing the solar spectrum as the sun mounts higher and higher in the sky and noting the effect produced by the consequent diminution in the length of path of the radiation through the earth's absorbing atmosphere.

Another difficulty introduced by the presence of air lies in the fact that most of the materials used for making prisms and lenses—for example, rock salt—are hygroscopic. This fact necessitates the attainment of a dry atmosphere, not only within the spectrometer equipment, but during the production, handling and storage of the prisms and lenses made from the materials. Glass and quartz are free from this defect and for that reason are, within their limitations, the most widely used spectroscopic materials.

The accompanying table summarises the facts and figures presented above. In it quartz is included. It will be noted that the lower limit of transparency of quartz is given as being about 0·18 micron and the upper at about 4·5 microns. Quartz is, however, subject to some special considerations which will be discussed later. For the time being we need only note that the figures given in the table place the limits of transparency of quartz a little beyond the range covered by the transparency of glass.

*Table of Wavelengths in Microns*

| | |
|---|---|
| Ultra-Violet | 0·12 lower limit of fluorite transparency. |
| | 0·18 lower limit of transparency of air, gelatine, rock salt and quartz. |
| | 0·35 lower limit of glass transparency |
| Visible | 0·4 limit of visible violet. |
| | 0·8 limit of visible red. |
| Infra-red | 1·2 limit of photo-sensitivity. |
| | 3·0 upper limit of glass transparency. |
| | 4·5 upper limit of quartz transparency. |
| | 9·0 upper limit of fluorite transparency. |
| | 15·0 upper limit of rock salt transparency. |
| | 23·0 upper limit of sylvite transparency. |
| | 28·0 upper limit of potassium bromide transparency |

*( To be continued )*

# Fifty Years of Undercarriage Development

No. IV—*(Continued from page 299, Sept. 4th)*

*The previous articles in this series have reviewed phases in the evolution of the aeroplane undercarriage leading to the development of the multi-wheeled installation. This part is concerned with a description of some of the civil and military units which have been made in this country, the remainder of which are to be described in the concluding article. The installations noted here fall into two groups, one group having a bogie beam mounting tandem double-wheeled axles and the other group of units mounting independent forward and trailing wheel levers.*

THE multi-wheeled bogie undercarriages developed in this country fall into two main categories: those employing a rigid bogie beam carrying wheels in tandem and mounted centrally from a shock-absorbing strut, and, in the other category, designs which in effect employ a double lever suspension arrangement with leading and trailing arms suspended from a solid strut. Both kinds also mount pairs of wheels in tandem on each leg, and all wheels rotate independently.

The production "Comet" aircraft employs this latter arrangement, the undercarriage being de Havilland's own design. Each leg is hinged only at the main spar and retracts sideways into the wing without further articulation. The wheels are cantilevered in pairs forwards and aft from a common hinge on the main leg, which is not a shock-absorbing member. The levers are connected between their centres and a cross beam pivoted to the solid leg, one by means of a solid link and the other by the main shock-absorbing member. It will be seen from Fig. 26 overleaf that by this linkage upward movement of either wheel arm relative to the other compresses the shock absorber. The slamming tendency to which we have referred applies to this design and most others where the bogie hangs rear wheels down.

It is suggested by Cussons that this action can result in dynamic loads upon the tyre being greater than three times the static stress for which they are normally designed, and might impose a weight penalty as a result of the stronger tyres and wheels required. Furthermore, the pitching oscillations initiated demand a substantial damping unit in addition to the main shock absorbing member. The subsidiary shock absorber on the "Comet" can be seen in the illustration on the rear wheel arm.

The protype "Comet" had a single wheel and tyre on each leg, which with brake assembly weighed a total of 3815 lb, being 3·6 per cent of the a.u.w. The bogie design illustrated complete with wheels and brakes weighs only 3598 lb, the two single wheel and brake assemblies weighing 341 lb more than the eight smaller wheels, whilst the other bogie undercarriage components weigh 124 lb more than with the single-wheeled legs.

The bogie installation which was developed for the second "Brabazon" by Dowty Equipment, Ltd., is shown in another of our illustrations, Fig. 28. Each leg consists

Fig. 26—The "Comet" Installation with One Tandem Pair Removed

of angled side frames of substantial H section forgings, which fork outwards and backwards to the rear spar hinge. They have a vertical lower portion carrying the common axle on which rearward and forward facing levers pivot. In this design each wheel lever has a main "liquid sprung" shock absorber, their lower ends pivoting on the wheel axles, with their upper ends turning on a common shaft. This shaft is itself mounted on a vertical member between the rigid vertical side frames and free to pivot at its other end about the same shaft as the wheel levers. The wheel arms and suspension units are thus free to pivot about this main shaft. Anti-pitching dampers are fitted between arms integral with the vertical shock absorber lever and the main side frame structure. In the case of a tail-down landing the rear wheels will tend to rotate the bogie about the main pivot, whereupon the anti-pitching damping pistons are pulled downwards. Fluid is then forcibly displaced through restrictor orifices in the piston head, which contributes initially to the main damping action and also opposes the pitching tendency.

These dampers also have an interesting subsidiary function as jacks in the retraction operation. For it is necessary to pivot the bogie about its main shaft relative to the leg, first clockwise and later anti-clockwise, in order that the bogie can negotiate the front wing spar and assume its horizontal retracted position. A fourway control valve is used, operated by a cam and follow-up linkage, whereby oil is admitted to the dampers or jacks, first to one end and then to the other.

The brake reaction on this design is taken from each brake backplate by a lever which is connected with the side frame by a link, the centre line of which for a given static load is concurrent with the ground line and the wheel lever centres.

Of the undercarriages which fall in the rigid beam category there are notable differences in the method of attachment to the leg and of methods of retraction. The arrangement adopted by British Messier, Ltd., for the Bristol "Britannia" air liner is illustrated herewith, Fig. 27. Each main undercarriage assembly consists of an oleo-pneumatic strut, hinged to the rear shear web of the wing spar (between the lower keels of the inboard nacelles). Its lower end carries through a centre hinge the bogie beam and it is braced against side loads by integral arms with which it hinges to the wing spar. It is locked down by a forward telescopic radius rod, which transfers fore-and-aft wheel loads to the nacelle lower keel members. The oleo strut has a vertical range of 15in from closure to full extension, with a static position (maximum take-off weight) 6·5in from full extension. As with other systems, rotation of the lower part of the oleo strut is prevented by torque links. The bogie beam is a light alloy forging, which can be rotated backwards and forwards by a hydraulic jack attached to its forward end; this jack is selflocking in the extended position. The bogie is free to pivot through about 15 deg. at low rotational velocity, but is progressively resisted by a damper as the velocity increases to prevent higher frequency oscillation.

The brake reaction is taken from the front wheels by a single member, which is constrained to remain parallel to the bogie beam, and it joins with the backplate taking the reaction from the rear wheels. The brake reaction is thus transferred to the leg through a single link and, as previously described, can be made fully compensating for a particular landing weight.

Another Messier bogie undercarriage is that fitted to the Short "SA4" bomber. It

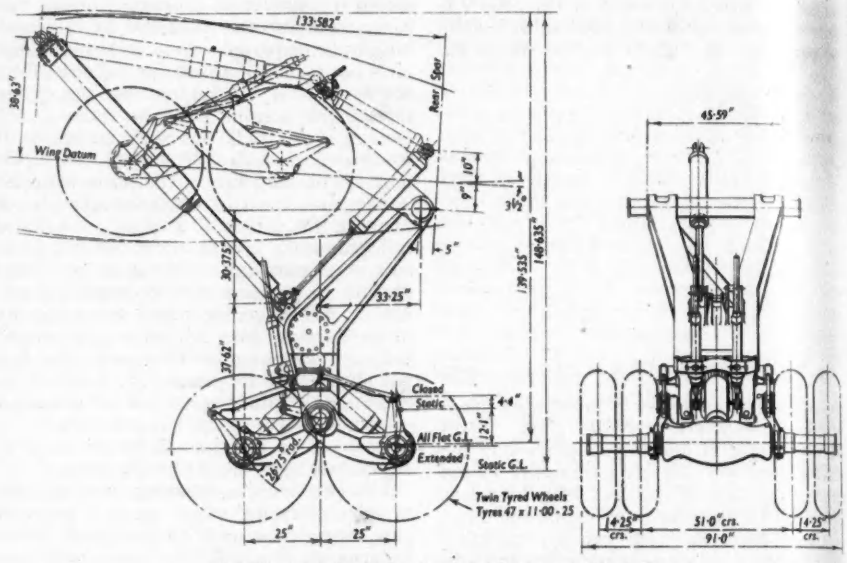



Fig. 28—Bogie Developed for the "Brabazon" Mark II

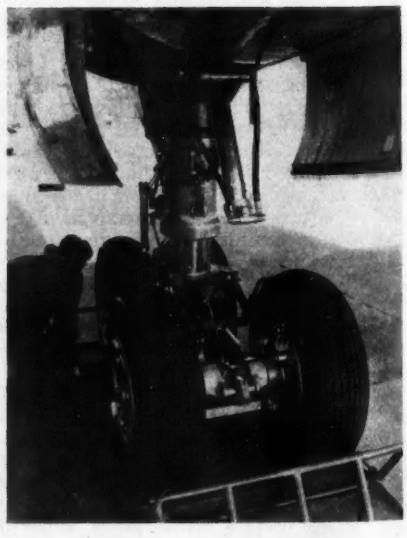


Fig. 27—Bristol "Britannia" Bogie

employs an orthodox leg consisting of an outer tube in which is housed a variable orifice shock absorber, secured at the upper end to the outer tube and at its lower end to the sliding tube, this arrangement, as explained earlier in this article, relieving the glands of bending loads.

The articulated radius rod, which has a built-in down lock, picks up on the outer tube and retraction jack. The latter is attached to a swivelling cross tube built into the wing structure. The main leg and aft drag strut also pick up on this cross tube.

The bogie is attached to the sliding tube, which in turn is retained, on reaching maximum extension, by an internal stop on the outer tube. The bogie beam is a light alloy forging with cantilever axles inserted at each end and the hop damper is mounted angularly between the bogie and main leg.

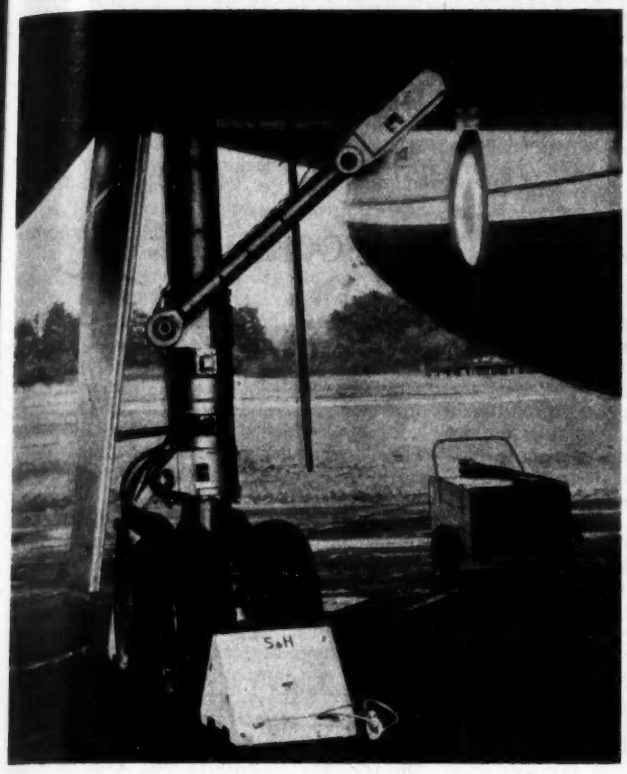


Fig. 29—The Short "SA/4" Installation

During retraction pressure is fed simultaneously to the retraction jacks and down locks, causing the latter to unlock and allowing the articulated radius rods to fold upwards in the direction of the cross tubes, thus retracting the main legs inboard.

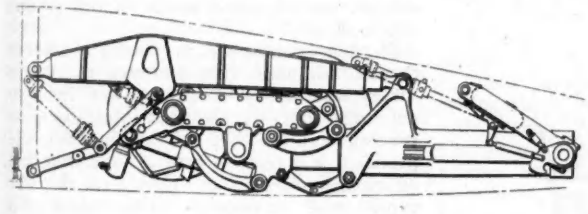
No brake compensation linkage is fitted in this installation. This has not been found necessary, due, it is stated, to the design of the anti-hop damper which operates on both sides of the neutral position. The hop damper is in effect a combined centring unit and damping unit. In this design the bogie hangs front wheels down so that the front wheel ground reaction initially has a much shorter moment arm about the beam pivot, thus reducing the slamming tendency.

The installation designed for the Handley Page "Victor" by Electro-Hydraulics Ltd., is also in this category, having an orthodox oleo-pneumatic leg with the bogie beam centrally hinged.

The drawing in Fig. 30 shows the axle stays bracing the structure against side loads and carrying the vertical loads to the undercarriage attachment points, the undercarriage being braced against torsional loads by the yoke structure.

The radius rod in this design is not articulated, which, it is claimed, offers a weight advantage and consequently the retraction links and jacks are stressed only by retraction loads.

A dashpot jack unit apart from acting as an anti-hop damper is proportioned and aligned to contribute substantially to the landing action. In the air it holds the bogie beam at an angle of about 45 deg. and the velocity and extent of the damper closure occurring before the front wheels touch down enables up to one-third of the vertical energy to be completely dissipated.



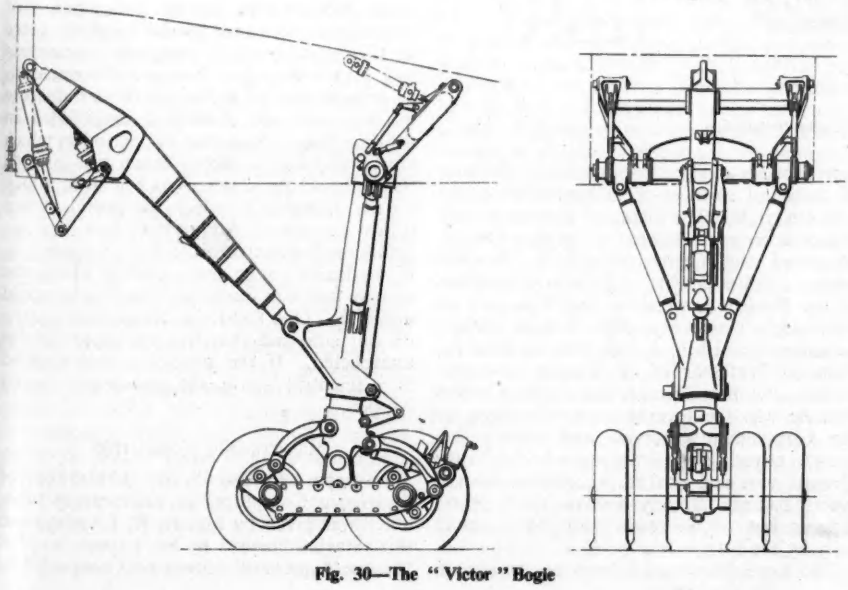


Fig. 30—The "Victor" Bogie

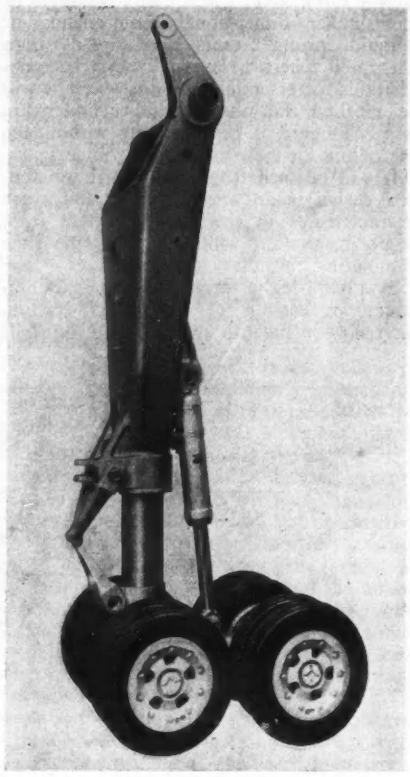


Fig. 31—The "Vulcan" Installation

The overall length of the main shock absorber can therefore be shorter and the reduced resilience of the undercarriage effected upon full closure improves the rebound characteristics.

The radius rod is a box structure of light alloy extensions, closed with side plates and stiffeners. Although it is mounted to take only axial loads in compression, during retraction it has to withstand considerable bending stresses due to the proximity of the jack load to the hinge and consequently it has its greatest section at that point. The main cylinder radius rod lug is machined in order to induce the stress to flow tangentially into the cylinder walls, thus eliminating purely radial loads at that point. The torsion box construction of the bogie beam consists of two light alloy forgings bolted and dowelled together.

Retraction is effected by the collapsing action of the main retraction jack on linkage connected to the radius arm, and it is assisted by other jacks which extend against the yoke

and rotate it backwards. It will be observed that, when retracted, the radius arm, main leg and the bogie beam are all folded horizontally. The bogie beam has thus to be pivoted to an angle slightly greater than 90 deg. and to allow this the subsidiary dashpot jack unit is made telescopic. The inner member forms the shock-absorbing agent, which extends against a spring in an outer cylinder during retraction. In this operation the bogie engages a cam on the radius arm, which guides it to its final position. The brake reaction linkage is an actual application of the system described by Collinson.* The company has stated that the weight of the complete tricycle installation does not exceed 3 per cent of the a.u.w. of the aircraft.

An installation distinguishable in several respects from the foregoing designs is that illustrated in Figs. 31 and 32 and is made by Dowty Equipment, Ltd. The advantages of the smaller dimensional requirements of "liquid sprung" units have already been illustrated where a levered system becomes desirable or essential, and in which it will be recalled the plunger ,and cylinder are largely relieved of bending loads without the use of one or more additional cylinders.

It will be seen from our illustration that this design is an attempt to exploit these characteristics to their fullest extent in a bogie installation whilst at the same time eliminating subsidiary dampers.

The main leg is formed by a magnesium-zirconium casting of box cross section, increasing in breadth and width to the shaft on the aircraft structure where it pivots. Through its lower end sticks a tube which carries the front wheel axle on which the bogie pivots, but which does not offer any upward axial resistance. The vertical load is wholely transmitted from the centre of the bogie beam to the main casting through the liquid spring unit, which is aligned almost vertically. The sliding tube, therefore, exists primarily to take the horizontal loads.

In the air the bogie hangs rear wheels down with the sliding tube at the limit of its extension. Consequently upward movement of the rear wheels on ground contact can only pivot the whole beam about the front end and cannot impart to the front wheels a downward velocity. The design thus has the advantage of eliminating the slamming action of the front wheels and utilises the single shock absorber both for the main load, the initial rear wheel load and as an anti-pitching dashpot.

The design incorporates a very simple brake reaction linkage, which is fully compensating for all wheel radii. It will be observed that the single link connecting the brake backplates to the leg is always parallel to the plane of the wheel axles and consequently to the ground, and the forces and reaction are therefore concurrent at infinity.

Retraction is by a single jack operating on a toggle integral with the leg. The radius arm is articulated and consists of a solid lower member of "Maltese Cross" section pinned to the lower lug of the leg structure. The upper member is Y-shaped in order to carry the loads to the sides of the wheel bay structure. The whole strut is locked in the extended position by a horizontal strut between the knuckle joint of the drag strut and the main casting. This method of stabilising the drag strut has the advantage of virtually halving the strut length, thereby enabling the two halves to be made lighter for resisting compression loads. For retraction of the undercarriage the horizontal stabilising strut is unlocked from its attachment at the casting end and is allowed to slide through the casting as the drag strut folds in the air.

*(To be continued)*

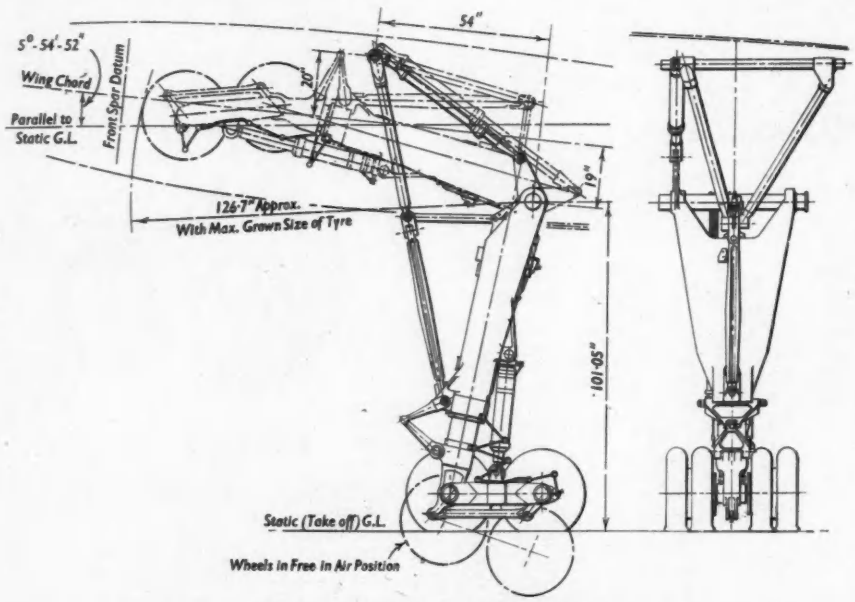



Fig. 32—The "Vulcan" Delta Installation

* See No. III *ante*.

# The British Association

No. I

## Inaugural Meeting

THE inaugural general meeting of members of the British Association attending the annual meeting in Liverpool was held in the Philharmonic Hall, Hope Street, on Wednesday, September 2nd. Because of the large number of members attending, the proceedings were relayed to an overflow meeting in the Liverpool Institute High School.

The Vice-Chancellor of the University of Liverpool, Sir James Mountford, M.A., D.Litt., D.C.L., LL.D., who expressed the regret for his absence through heavy pressure of duties of state of the Chancellor of the University, the Marquess of Salisbury, the Under-Secretary of State for Foreign Affairs, conferred the degree of LL.D., *honoris causa*, on Sir Edward Appleton, President of the British Association and Principal of Edinburgh University, Mr. Robert Birley, headmaster of Eton, and Sir Harold Jeffreys, Plumian Professor of Astronomy at Cambridge. Of Sir Edward, the Public Orator said he was the leading man of science in the Government's service and during the decade covering the war years he had discharged vast and vital responsibilities with a credit balance already known to be prodigious but which could only be assessed fully by the future.

The Lord Mayor of Liverpool, Alderman William John Tristram, J.P., and the Vice-Chancellor of the University having offered a welcome to the Association, Sir Edward Appleton, G.B.E., F.R.S., the President, took the chair and delivered his inaugural address, entitled "Science For Its Own Sake," which was broadcast by the B.B.C. Extracts from that address were printed in our last issue.

Professor A. V. Hill, C.H., F.R.S., the immediate Past President, thanked Sir Edward Appleton for his address, supporting Sir Edward's view that the guiding motive of the scientist should be curiosity and adventure and not philanthropy.

## Engineering in the Next Two Thousand Years

At a meeting of Section G (Engineering) on Thursday, September 3rd, Lord Dudley Gordon, President of the Section, presented his address under the title, "Engineering in the Next Two Thousand Years." The address was reprinted nearly in full in our last issue.

Sir Ben Lockspeiser, proposing a vote of thanks, said that what mattered in such a survey was not whether one was right in particular but whether one was right in general, and he had no doubt that the president was right in general in saying that we were living on our capital and that the capital was decreasing. The moral that Lord Dudley Gordon had drawn was that the days of hit-and-miss were over or nearly over. We had gone through a long period of empiricism. No one should laugh or sneer at the great band of engineers, scientists and others who had brought the world to its present state of technique in manufacture by informed and intelligent empiricism in the first place. Now that the period in which empiricism had to do so much was passing there should be a relentless scientific attack on the problems to which the president had drawn attention. Attempts to look into the future tended to create a feeling of pessimism. If we learnt to be more careful about the way we used our resources, that feeling would diminish. One factor in science was usually on our side and that was the factor of the unexpected. If the problems were tackled in a scientific spirit, the unexpected would happen.

## Electronic Computers

A paper entitled "The Utilisation of Electronic Computers in Engineering Practice," was given by Mr. R. K. Livesley, and this was followed by a paper, entitled "Some Aspects of Automatic Computing in

Aircraft Engineering," by Mr. G. C. Alway.

The subject was introduced by Professor F. C. Williams, Professor of Electrical Engineering at the University of Manchester, who said that the object of the session was to "deglamourise" the electronic brain and present it as a potentially powerful new tool to aid engineering design and to help solve problems. The computer could lead to economy in the use of material and reduce the factor of ignorance without reducing the factor of safety. What was feared was that too much attention might continue to be paid to "glamour" and too little to the every day usefulness of the machine. The ordinary man-in-the-street had no need to be frightened by the machine, for it was concerned primarily not with higher and higher mathematics but only with faster and faster arithmetic.

The Manchester computing machine, which was designed in his department, could do 100 man-hours of human figuring every week. The use of the machine by outside organisations was increasing steadily and those who used it found themselves calling upon its services to an increasing extent. A continuing expansion of its use was anticipated. The machine was not suitable for all engineering calculations, but its use might extend far beyond what was at present envisaged.

He wished to forestall two questions: one was: how reliable are these machines? The other was: how do we know that the answer, when we have it, is right? On the question of reliability no one would pretend that the machines were as reliable as a well engineered and fully developed tool such as a hammer, but, on the other hand, they worked for about 80 per cent of the time they were expected to work and they were reliable enough for businessmen to continue paying for their use. As to the accuracy of the answers, the problem was no different from what it was with any other method of computation. Machines made mistakes, but so did human computers and both must be checked. Having regard to the speed of the machine, its errors represented less than one mistake per annum by a human computer, and it was commonplace for a machine to make 1,000,000 additions without error. To paraphrase a famous phrase: "Up with this, man cannot keep."

Mr. R. K. Livesley, in presenting his paper, said that digital computers were most economically used when working on repetitive problems such as in connection with calculations very often carried out in engineering design offices where many people were carrying out the same numerical work. The preparation of the programme for the machine could be compared with the production of a machine tool.

Mr. G. C. Alway, in presenting his paper, said that the National Physical Laboratory increasingly found aircraft designers customers for the use of the pilot A.C.E. computer. Digital computers became more powerful the more they were used, and for the efficient use of a computing machine it was necessary to have an elaborate organisation of programmers so that the actual use of the machine could be left to unskilled people.

Asked if the machine could be put into reverse and a programme derived from the results arrived at, Mr. Livesley replied that the computer would only do what it was told to do and it would in no circumstances do mathematics for the operator. It would do arithmetic according to a prearranged scheme, but it could not tell one how to do the problem. Feeding ordinary algebraical symbols into the machine to enable it to produce a programme had not been done in a sufficiently elaborate manner to enable the machine to programme as well as a human being could. The machine could do the easy parts of the calculation, which the operator could do, in a quarter of an hour, but the operator still had to decide how the calculation had to be done. The algebra had to be translated into machine code. In the computing world there was a certain cleavage of opinion as to whether there was any future in programmes which generated programmes.

In reply to another question, Mr. Alway said that normal checks were programmed in the same way as the original computation and the machine did its own checking, and occasionally errors were discovered. Replying to further questions, Mr. Livesley said that when it was stated that a programme could not be done on a digital computer the reason might be either that one did not know how to do it or, if one knew how to do it, a big enough or fast enough computer was not available. Computers were gradually being built with bigger memories. If investigation showed that it was difficult to get a problem into an existing computer, that would probably spur Professor Williams on to building a computer which would deal with it. However, existing machines had stores sufficient for the performance of very useful work.

A questioner said that it had been stated in the Mathematics Section that it would be possible for one to have as much computing as one liked at 10s. per minute. Mr. Alway and Professor Williams replied that the charge for the use of their machines was £20 per hour.

### Recent Developments in Dielectrics

In Section A, on Thursday, September 3rd, Dr. S. Whitehead, Director of Research, Electrical Research Association, gave an address on "Recent Developments in Dielectrics."

He first dealt with the history and the principles of the subject. Turning then to recent developments, he said that hydrocarbons were non-polar and could be highly purified. They were excellent electrically, but solid paraffins were poor thermally and mechanically, largely because the chains were short. Polymerisation could provide chains with hundreds and thousands of atoms, and by avoiding or minimising plasticisers, anti-oxidants and the like a low loss angle of 1 : 3 or $4\times10^{-4}$ up to $10^{10}$ c/s could be achieved with polythene and polystyrene, which did not soften until about 100 deg. Cent., but crept at low temperatures. Polythene had crystallites, like a spherulitic mineral crystal, which were connected by amorphous regions. It could be processed like rubber and used for cables and insulators. Polystyrene was harder and was used mainly in sheets. To increase the temperature range and mechanical strength the hydrogen in polythene could be replaced by fluorine to give P.T.F.E., which was hard and quite strong up to temperatures of 300 deg. Cent. In a dense texture P.T.F.E. would be resistant to discharges, but it was also used in a looser form wherein discharges could occur. If one of the fluorine atoms was replaced by chlorine, the softening temperature was reduced to 200 deg. to 250 deg. Cent., but the material was easily processed and, according to the porportionate crystallinity, could be transparent and flexible or translucent or more rigid. Unfortunately, the asymmetry of the molecule caused a rather catastrophic increase in loss angle, but it was acceptable in many applications. Polystyrene could be stiffened and raised to 120 deg. Cent by forming a copolymer with acenaphthalene without much increase in loss angle, but was much more brittle.

Cross linking in polythene could be achieved in a remarkable way by neutron bombardment in an atomic pile. The discovery was too recent to say other than that the strength and heat resistance were appropriately increased, but it seemed to open up a new potentiality for the peaceful use of atomic energy. Cross linking appeared to occur in the certain resins, an example of which was araldite. They were mechanically very strong and highly adhesive, but, comprising only carbon, hydrogen and oxygen, were limited to use at temperatures not much above 100 deg. Cent.

In the silicones the silicon-oxygen link seemed to cause an energy loss at very high frequencies, but up to those frequencies the energy losses were negligible. The replacement of carbon by silicon gave a temperature range up to 200 deg. Cent. and provided remarkable mechanical properties. The viscosity in liquids could be continuously increased by lengthening the molecular chain without altering the electrical properties. Solid silicones could be plastic for slow stresses and elastic for fast stresses, whence the name "bouncing putty."

There were, essentially, very few dielectrics which did not absorb moisture. There were crystals like quartz and mica, and glass. The silicone molecule, with its oxygen linkage, was hydrophobic. The polarity of P.T.F.E. arose from asymmetry with chemically similar atoms and it was unaffected by water. The non-polar plastics, such as the condensed hydro-carbons, were but slightly affected by moisture. The properties of polar plastics or polar materials in general were dominated by absorbed moisture, even though there were degrees in that aniline was better than phenol in formaldehyde resins. Similarly, nylon and terylene fibres did not exhibit the macroscopic absorption of moisture as did paper and natural textiles; the needs of insulation and underwear were not the same.

It was possible to dry dielectrics, but difficult to keep them dry. Metals and some crystals were impermeable to moisture, but other materials let moisture through more or less slowly. At present, with the bulk of insulation, one slowed the ingress of moisture to cover a reasonable working life, and with high-grade insulation one used dielectrics little affected by moisture or resorted to hermetic sealing. The most widespread example of sealing was the high-voltage cable, but great advances had been made in the sealing of components like capacitors, even for the tropics.

What the public called plastic mouldings, and glass-bonded mica and exfoliated mica, were like concrete in that the filler was bound by resin on glass, but laminates like varnished paper resembled reinforced concrete when the fibres were long and strong. Although the cellulose molecule was stable and not easily ionised, particularly if it ended in a calcium ion, it was polar, collected moisture and decomposed above 110 deg. Cent. It could thus be replaced with some advantage by glass, terylene and nylon. As binder silicone, a polyester resin (an organic isocyanate), or a nitrogen-containing resin like melamine, could exploit the properties of high-temperature, moisture discharge and tracking resistance and low losses. But there were disadvantages such as cost and bonding difficulties as between glass and silicones. Thus, although remarkable laminates had been produced, over half the bulk of insulation was still varnished paper. *A fortiori* cost applied to the considerable technical achievements of synthetic mica and

quartz which were thereby restricted to laboratory scale use.

There was now a queer group of substances with a ridiculous name—ferroelectrics. Rochelle salt, titanates and niobates, among others, formed crystals in which the bonding was delicately poised between ionic and homopolar, so that the dipole moment of the unit cell changed greatly with small disturbing forces. At low temperatures the unit cell had a dipole moment, implying the presence of domains. The dipole moment vanished at the Curie point of an order-disorder transition, but a high polarisability and permittivity remained at temperatures just above the transition. The domains caused hysteresis; the permittivity could be greatly changed by a superposed polarising electric field and was also affected by mechanical forces, such as electrostriction. In those features they were analogous to ferromagnetics, but their properties arose from a more accidental kind of structure. They made very small capacitors, the interaction between alternating and unidirectional fields enabled a dielectric amplifier to be made, analogous to the magnetic amplifier, and they would convert or transduce mechanical into electrical changes. In anti-ferroelectrics the ordered state comprised dipoles in parallel, but opposite, directions, instead of mainly in one direction, so that their permittivities were lower.

A thin dielectric withstood a high electric field, but usually, except with mica, two or more layers were needed owing to chance defects. Recently good thin films had been made from polystyrene, polythene, isocyanates, and the like. In a particular use of polystyrene films a necessary heat-treatment left residual stresses on cooling. Dr. Whitehead said that his colleagues found that the films often tore into holes when plasticised by spots of human grease. The film was statically charged at that stage and attracted, from the female operatives' heads, dandruff which was greasy except just after a shampoo. With metallised paper defects could be destroyed by the local short circuit when proofed. In the electrolytic capacitor the thin electrolytically formed film was self-healing if pierced. Recently a satisfactory oxide film had been formed which could be used dry. Theoretically a thick film could be built up with alternate layers containing free electrons, but practical success was elusive.

Internal discharges and, in some degree, external discharges began a breakdown path by erosion due to local heating, a thread or spiky decomposition with intrinsic breakdown at the tip. At high frequencies, or if the damage was extensive, discharges might cause thermal instability. Below a stress of 50kV (crest) per centimetre good insulation was not much affected by discharges. Above that it was desirable, by care in manufacture, to prevent voids between sections of homogeneous insulation or between the dielectric and the conductor. Conducting or semi-conducting films were useful there. In varnish impregnation some success had been achieved with solventless varnish, which did not change in volume when it set. The greatest advance had, however, been in the use of oils, compounds or gases under a pressure of, say, 10 atmospheres, by which the voids were both reduced and filled by a fluid of about three times its normal electric strength. Working stresses of 200kV (crest) per centimetre had been reached and pressure cables of that type had reached a breakdown strength under impulses of 2MV per centimetre. New gases such as freon and sulphur hexafluoride with high electric strengths now played their part mainly in reducing surface and edge discharges, but air and common gases in enclosed apparatus at up to 40 atmospheres pressure were emerging from the laboratory stage in electrostatic generators.

With direct current and, to a less extent, with alternating current some electrolytic action went on and often limited the life of insulation. Moisture had already been mentioned, but not infrequently the action generated active gases, of which nascent hydrogen was an important example. It could, however, be absorbed harmlessly by certain substances known as stabilisers and the life greatly lengthened.

Dr. Whitehead said that, although he had tried to show the application of physical theory to dielectrics, he had talked mainly about engineering. His excuse was that in any piece of electrical equipment the part to which dielectric theory could be applied was quantitatively small, however vital its importance and however fascinating its scientific conceptions.

## The Outlook for Economic Nuclear Power

A paper entitled "The Outlook for Economic Nuclear Power" was given at one session of Section G on Friday, September 4th, by Dr. B. L. Goodlet, O.B.E., Deputy Chief Engineer, Atomic Energy Research Establishment, Harwell.

It is remarked in the paper that nuclear-electric power will be economically sound only when it can compete with conventional electric power without support from a Government market for weapon material that may collapse at any time. However, the concept of "economic" nuclear power has a meaning only in relation to the cost of conventional power in a particular locality. Our interest in nuclear power stems from the facts (*a*) that the national demand for electricity seems likely soon to outstrip the national output of coal; (*b*) that the economics of nuclear power may become more favourable as coal prices rise; and (*c*) that there are many countries in which the *per capita* energy quota needed to raise the standard of living cannot be obtained from available sources of conventional fuels.

Nuclear power will originate within the existing atomic weapon industry in which the United States alone has invested over £4,000,000,000.

Present production piles run at relatively low temperatures and the fission heat is wasted. The only route to nuclear power discernible at present is to build reactors that will run at higher temperatures and generate steam for power plants of conventional design. Possible reactor fuels are natural uranium with only 0·7 per cent of fissile material and various enriched fuels containing a much greater percentage. The latter are hoarded and are much more expensive, pure fissile material being at least 100 times as costly as gold. The major elements of a nuclear power plant are a reactor, a heat exchanger in which the reactor coolant transfers its heat to water-steam, and a turbo-alternator. Steam temperatures and pressures will be lower than in normal power station practice because the reactor coolant must be hotter than the steam and the reactor interior must be hotter than the coolant, and the properties of available materials make it impossible to run the reactor as hot as one would like. We have to decide first whether such schemes are technically feasible; second, whether they are worth while from the standpoint of economics and national policy.

The technical feasibility of nuclear-electric power plants can be taken as established. At Harwell there has been designed an improved natural uranium reactor enclosed in a pressure shell, the heat produced being transferred by a gas under pressure through a heat exchanger to a steam turbo-alternator. The designed output and overall thermal efficiency of this plant are satisfactory and it is now being built. If guesses as to its life and cost prove correct, then, assuming no by-product revenue, the cost of electricity generated at a very high load factor should be about 1d. per kilowatt-hour.

American engineers have also made feasibility studies and seem to have concluded that nuclear electric power in the United States at present is uneconomic unless supported by revenue from the sale of plutonium for military purposes. This in turn has disadvantages because "a dual-purpose plant would have to be designed principally as a plutonium production plant. The design of the plant would be maximised for plutonium production at the expense of power production, because there are definite design conflicts. In order to avoid excessive losses of the vital plutonium the fuel elements would have to be discharged long before their value as fuel had been exhausted."

Dr. Goodlet added that since he wrote the paper the Americans had found that the capital cost per kilowatt of a nuclear power station was between two and four times that of a conventional coal-fired power station, and therefore the annual charges would be two to four times greater. He concluded by saying that it might be felt that his outlook was a little disappointing, but it was nevertheless much better that all surprises should be pleasant ones. It was just ten years since the first nuclear reactor at Chicago went into action. Nothing was ever as bad or as good as it looked at first, and that went for the prospects of nuclear power as for other things. Those concerned would press on with their job without being elated by their success or depressed by their difficulties.

In reply to questions, Dr. Goodlet said that everybody knew that radio activity was very dangerous, but the precautions taken at Harwell were such that although he lived 500 yards from the pile he was not worried. The total accidents involved there were less than the average in industrial factories. It was not essential to have in the reactor a circulating fluid which was not the working substance in the prime mover, but most people seemed to think it was convenient. Asked if that did not involve an important loss of energy and if some temperature drop and loss of availability would not be saved if the working substance could be put directly through the reactor, Dr. Goodlet said that there were many factors to consider, of which the fluid was only one. In reply to further questions about the disposal of radio-active substances, Dr. Goodlet said that the elements derived from fission had radio-active lives varying from minutes and hours to months and years. Disposal was a long-term problem.

Piles could be built where material was cheap and where water power was available, but if those sites were inaccessible and towns had to be built near them for scientific staff, supposedly more expensive sites might be found to be cheaper in the end.

Mr. J. Eccles, the chairman, said that, assuming that coal disappeared, even if we were successful in producing breeder reactors, we should presumably

still be faced with the problem of having to import all our fuel resources, assuming that we were wholly dependent upon raw uranium for the process. What were the economic prospects of a country which had to import the whole of its fuel resources ?

Dr. Goodlet said that that question applied to any raw material and not only to uranium or another fuel. His reply would be to point to Switzerland, whose only resources were scenery and water, and yet it was one of the most advanced industrial nations in the world and had a very high standard of living, all achieved by the brains of its people. We must continue using our brains.

Mr. Eccles said that the problem was a vast one and it was difficult to conjecture what it meant in technology, in terms of economics and in terms of our ultimate survival as an industrial nation. Many things had burst upon the world with explosive force but the wisdom of mankind had translated them into a source of very great benefit. That was what atomic fission would ultimately amount to. In 1953 we were at a very early stage in the process. Perhaps in 1973 a paper would be presented about, not the prospective advantages of fission processes, but the realised advantages throughout a large part of the world. The present stage was a stepping-stone, a landmark in the history of a new and most fascinating subject.

### Solar Energy : Past, Present and Future Applications

Dr. H. Heywood, Reader in Mechanical Engineering, Imperial College, then presented his paper entitled " Solar Energy : Past, Present and Future Applications." The paper drew the following conclusions :—

The possibilities of using solar energy must be examined impartially against the background of future developments in the fuel supply situation, and the present economics must not be stressed too greatly. Over optimism is as great a danger as undue pessimism, for it is clear that applications in the near future are limited, though the potential applications are significant. It is evident that solar energy utilisation has no prospect of success in large communities, but in isolated areas with semi-tropical climates there are many fields of application ready for development. As fuels become more scarce and costly so will the economic balance become more favourable, and experience gained now may prove of the greatest value in the future. Many of the possibilities which have been described in the paper involve no new principles, but success is dependent upon careful design and the introduction of new materials of construction as these become available.

Research on solar energy utilisation ranges over many fields of science : solar physics, meteorology, the physics of heat transfer, thermodynamics, thermoelectricity, plant growth and chemical synthesis. Once an interest in the subject has been roused, few will relinquish the hope of achieving an objective that could benefit many peoples in countries at present only partly developed, and would enable " two ears of corn, or two blades of grass, to grow upon a spot of ground where only one grew before."

( *To be continued* )

# The National Radio Show

THE National Radio Show which, this year, is being held at Earls Court, was opened on September 2nd by Field-Marshal Montgomery, and will close to-morrow. This show serves the interests not only of domestic radio and television but also of industrial and Service applications of electronics. Some innovations are to be seen in the television control system which has been established jointly by the Radio Industry Council (R.I.C.) and the British Broadcasting Corporation. In previous years the control room has produced a closed circuit programme to allow television receivers to be demonstrated throughout the times of the exhibition every day. This year the B.B.C. has arranged to stage, twice daily, small programmes which may be transmitted from the national television network. For this purpose the quality of pictures emanating from the exhibition studio and its associated control room must be very high.

There are two main requirements : the first is to enable the B.B.C. to obtain its excerpts for the television programme with the help of the Radio Industry Council's studio and cameras and the second to distribute programmes throughout the exhibition which may be obtained from five sources. These sources are as follows : (1) The normal B.B.C. service as received over the air from Alexandra Palace ; (2) films which can be transmitted by means of the film scanning equipment in the R.I.C. control room ; (3) the output from two television cameras located within the glass-walled studio associated with the control room ; (4) the television camera which covers the dais on which from time to time various radio, television and other celebrities will appear ; (5) pictures taken from the B.B.C. studio located in the exhibition which are fed through the control gear in the R.I.C. control room and subsequently to the receivers in the show.

As a further aid to programme continuity the installation includes a " Telescribe," a simplified form of caption scanner which facilitates the transmission of still captions or photographs printed on normal pieces of flat paper to be transmitted over the network.

The control room itself is divided into two parts, the apparatus bay and the studio proper. The television distribution equipment accepts signals from all the five sources mentioned above and distributes them at radio frequency through amplifiers to the cable network feeding all the receivers in the show. In the same equipment bay is housed the amplifier apparatus feeding the public address system which carries announcements as well as the musical programmes taken either from gramophone records or by line from the B.B.C. In addition, a private automatic telephone exchange is installed to effect quick communication between the key points in the exhibition.

The programme officer has complete operational control of the equipment from his position in the control room and may choose at will any one of the five programme sources previously mentioned. The programme is monitored, passed through faders and then fed to the main amplifiers for distribution by cable and thence to the receivers. From previous experience it was known that the internal television circuit could suffer from direct pick-up of the Alexandra Palace signal, resulting in interference. For this reason the sets in use are those for Channel 4 (Birmingham) using 61·75 Mc/s for vision and 58·25 Mc/s for sound. The waveform conforms to standard B.B.C. practice and each outlet in the show feeds only one receiver at a signal level of 1mV-3 db into 70 ohm unbalanced. The film scanner is designed to move the film continuously through the gate, interlacing being provided by a lens system in the scanner. Test equipment in the control room ensures that the standard and level of signal is maintained and continuous monitoring of the programme is carried out by the duty engineer. Glass windows enable visitors to the exhibition to see all the operations in the studio control room.

The exhibits shown by the Ministry of Supply include a radio-controlled rocket 25ft long and sub-miniaturised assemblies which are typical of modern radar construction techniques.

The assemblies to be shown include a balloon-borne unit which can give meteorological information through various layers of atmosphere from 70,000ft downwards. One item in this display is a pressurised unit which is part of a modern cloud and collision warning airborne radar system and consists of an inner sealed unit and an outer casing through which air is blown to cool the equipment. The inner unit is pressurised to about 5 lb per square inch at sea level so that if any leakage takes place it will be outwards and not inwards. This means that damp air (in tropical climates) will not be drawn into the equipment and cause corrosion. The need for pressurisation will be appreciated when it is recalled that a modern airborne radar system may be carried to heights of 50,000ft or more and at this altitude the air density is considerably less than that at sea level. This means that the breakdown voltages across high voltage terminals are in some cases one-third of their normal sea-level breakdown voltage. For modulators and transmitters, high voltages up to 20kV are commonly used and it is therefore necessary to maintain the pressure within the assembly at or around ground level.

Lightweight construction is shown as applied to radar sonde, a balloon-borne unit which ascends through the atmosphere at approximately 1000ft per minute to heights of 70,000ft when the balloon bursts and the sonde descends by parachute. Measurements of pressure, temperature and humidity are telemetered to an accuracy of one part in a thousand for each 250ft layer of atmosphere traversed. Information is continuously transmitted, enabling wind speed and direction to be computed. The system requires that pulses from a ground station interrogate the balloon borne unit, at a frequency of 152·5 Mc/s, which responds (at 2800 Mc/s) at each interrogation with two pulses, one immediately and another after an interval which is a function of the quantity being measured. Since the balloon-borne unit is expendable, light weight, economy in components, and simplicity of design are essential. The entire unit is enclosed in a thermally insulating container to maintain a constant internal temperature during ascent. The components exhibited include a complete airborne unit and samples of the 2800 Mc/s transmitter and 152 Mc/s receiver.

Another exhibit concerns potted circuit constructions as used in assemblies for telemetering and guided missiles. These assemblies occupy little space, the components are protected against shocks and vibration, and the potting resin used seals the components so that they are unaffected by moisture, dust, &c., during long periods of storage. The method of assembly is, first, to mount the components in a jig framework consisting of two simple strips of plastic suitably drilled, to insert this jig in a mould, and to pour in the casting resin which jells and sets hard in a few hours. No pressure or heat is required to form a solid casting. Connections are soldered to the component lead-out wires and in some cases printed circuit top and bottom plastic plates are used.

The stages in the construction of a typical printed circuit (which has the advantage of being suitable for mass production) are shown, beginning with the copper foil bonded to a plastic plate. The required circuit is then printed or screened on to the copper face in acid-resisting ink. The plate is then dipped in ferric chloride solution which etches away all unwanted copper, leaving only the lines protected by the acid-resisting solution. This method forms a basis for the development of automatic assembly machinery, in which it may be possible in the future to assemble small sub-units of the size shown, at the rate of approximately two a minute.

Although the transistor is not generally introduced into Service equipment, the characteristics and possibilities are being studied as exemplified in an exhibit consisting of a small multi-vibrator unit operating at a frequency of the order of 500 c/s. As the transistor is so small special components have been designed to be compatible in size and the resultant assembly is held together by potted techniques, as described above.

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## FUEL CONSERVATION

The members of that productivity team on "Fuel Conservation" which visited the United States in February and March of last year, and whose report was published last Monday, obviously yearn for much more co-ordination of the fuel and power industries of this country than exists at present. Like Sir Claud Gibb, whose lectures upon the subject a year or two ago are still recalled, they see coal as a wasting asset that needs to be preserved as long as possible. They believe the coal shortage is likely to become more severe; and, as will be observed from that part of their report which we reprint on another page of this issue, they think "It would be unwise to assume that any other form of energy will make a material contribution to the country's needs by replacing coal within, say, thirty years." In consequence, like others who have studied the problem technically, the members feel that there ought to be a national fuel policy in Britain.

But unfortunately as soon as the attempt is made to formulate a national fuel policy in more detail formidable difficulties are encountered. For example, a number of "vexed" questions are listed by the team. Amongst them are "Is it in the national interest that electricity . . . should be used for space heating . . . ? Is it not essential . . . that the functions of electricity be confined to the provision of power, light and certain specialised heat purposes ? Is not gas the right fuel . . . for space heating purposes (occasional heating) ? Where electricity is available should gas lighting be used for public services ?" It is very far from certain what the answers to such questions should be. The protagonists of electricity claim, for example,—we quote from a letter to the editor in our issue of September 12, 1952—that "with the present average generating efficiency electricity for domestic space heating competes in fuel economy with any other method, including coke, for periods up to six hours." Moreover, even if all the questions were answered in the particular way in which the members of the team probably think they should be, what action could be taken ? Is it suggested that coercion should be exercised upon industry and the domestic user ? Would coercion be politically possible ? For would the public accept as final, judgments arrived at upon grounds of fuel conservation alone ? The trouble in formulating a national fuel policy is that at least three conflicting factors are at war. A particular device may be more economical of fuel than any other. But it may not be the most economical in terms of money; and it may be the least convenient in use, a point not without importance domestically as it affects standards of living and industrially as it affects ease of control. The Ridley Committee, whose report was published last September, six months after the productivity team had returned from America, came to the conclusion, after giving deep consideration to the many factors involved, that the choice of fuel should be left to the individual consumer guided by the prices he was asked to pay; and that the purposes of fuel conservation would then be served if prices closely corresponded to the relevant costs of supplying the different fuels. Unfortunately, however, it is very difficult to equate prices to costs in that way. It is, for example, far from simple to devise electricity tariffs which truly reflect the costs of providing current at peak and off-peak hours and which, at the same time, are not only fair in themselves but so demonstrably fair as to be so accepted by all users. Nor is it even simple to fix prices for coal. The members of the Ridley Committee proved equally divided as to whether the prices ought to be based on the average costs of production as at present (so that about half the coal produced is produced at a loss), or whether the prices should be raised to cover marginal costs, the condition that would rule, under the influence of the laws of supply and demand, were there competition within the industry. Thus, the Ridley Committee merely favoured the setting up of a tariffs advisory committee; whereas the productivity team, probably less aware than the Ridley Committee how formidable are the difficulties, clearly expects that a committee of investigation, it proposes should be set up, would be able within two years or so to reach agreed conclusions upon a full national fuel policy. For our part we think it very improbable that it would! But if the Ridley Committee seems in that respect better advised than the team there is much in the latter's report that supports and gives emphasis to the former's conclusions. It is disgraceful that the people of this country should be "by far the most inefficient users of fuel in Europe," a fact perhaps explained but certainly not excused by the abundance and cheap cost of coal in the past, the insignificance in many industries of fuel costs in relation to total costs and the greater urgency felt by many firms to invest limited supplies of capital in projects other than those which would bring fuel savings.

It is a conclusion to be drawn from the Ridley Report and no less clearly from the present one that the Government should aim to make what is profitable to the nation by fuel conservation also profitable economically to individual fuel users. The Government has already taken action upon those lines by providing an incentive through a twenty year loan scheme for industry to improve its fuel using plant; and by the setting up of a much enlarged fuel efficiency organisation under the British Productivity Council. A very wide field for improvement may be affected by these policies, by the replacement of much antiquated steam-raising plant, by the installation of back pressure and pass-out generating sets supplying process heat, and by the reduction of wastage in process plants. Moreover, if American experience can be taken as applicable here, back pressure power stations supplying district heating and process heat for industry are likely to prove monetarily economic as well as contributing to fuel economy. Some of the detailed technical suggestions of the team are likely to prove of much value to firms making and installing new equipment in this country. But these actions of the Government have not, of course, had any influence upon the co-ordination of the activities of the fuel and power industries. There the productivity team would like to see set up "a single permanent and non-political fuel and power board to undertake the higher direction of these three national industries." But it is difficult to see what the board could do technically towards co-ordination that the Minister, advised by a competent Ministry, is not already empowered to do. For though the team envisages a non-political board, as opposed to a Minister who is anything but non-political, the hope that it would be able to originate policies on technical grounds alone, unaffected by politics, is vain. Once an industry has been nationalised the Government, in public understanding, becomes answerable for its actions.

### MORE THOUGHTS ON A.T.C.

It was perhaps no more than natural after the catastrophe at Harrow last autumn that attention came to be concentrated largely on the warning aspects of automatic train control and cab signalling. The burden of many letters in the press has been to see the establishment of means to warn a driver and fireman who were heading towards such a holocaust ; and the Inspecting Officer of the Ministry of Transport indirectly sets his seal upon this particular trend of thought by his view that, in connection with a system of multi-aspect colour light signals, there is no need to differentiate between the double-yellow and the single-yellow of the lineside signals in the audible indications provided in the cab. In his view the same " warning " indication can be given for both. Now it seems to us that a very important point in railway operating practice is here involved. The long and difficult history of signalling evolution seems likely to repeat itself with the general adoption of A.T.C. in this country and in view of the large sums of money concerned the point cannot, in our view, be over-emphasised. In the early days of railways, signalling was installed primarily as a means of warning a driver, and indicating to him in precise terms where he must stop. Similarly to-day the " warning " value of A.T.C. seems uppermost in the minds of those charged with the development of the new standard system. But in the case of signalling, once the means of warning had been developed to something near perfection, railway operating men found in the multi-aspect day colour-light signal a means of expediting the flow of traffic in busy areas. Modern electrically-controlled signalling has come to be regarded as a predominant part of the equipment, without which the more intensive services could not be run. Signalling technique has progressed a very long way beyond giving a simple " yea " or " nay " to the driver. With four-indication colour-light signals he is now told the state of the line ahead.

With A.T.C. as now proposed on a national basis it seems that the clock is to be put back. In early experimental days on the Great Western, and elsewhere, the hope was expressed in some quarters that audible cab signalling coupled with control of the train brakes would make distant signals unnecessary. Nowadays, however, there is general agreement that A.T.C. and audible cab signalling should be a supplement to the wayside signals—never a substitute for them. But it is now proposed that the same audible cab signal should be given for both the double-yellow and single-yellow of a multiple aspect system as for the distant signal in mechanical territory. If one regards A.T.C. only as a last line of defence where a driver is ignoring signals, all well and good. The wayside signals are displaying a warning aspect, either preliminary or final, and the driver is given an audible indication to supplement those wayside indications. But the use of colour-light signals, particularly in misty weather, has proved of such inestimable value in keeping trains on the move that it seems a pity that differentiation between the yellow and the double-yellow is, apparently, not to be made in the new standard arrangement of A.T.C. On some lines, as mentioned in Colonel Wilson's report on the Harrow accident, the installation of multi-aspect colour-light signals was considered an acceptable alternative to A.T.C. The close spacing of the signals, particularly in the electrified suburban area of the Southern Railway, keeps drivers constantly on the alert, and it was considered that the chances of signals being misinterpreted, or missed altogether, were thereby lessened considerably. In the North Eastern Region we have known of express passenger and fast freight trains running at 55 to 60 m.p.h., continuously on the " double-yellow," their drivers knowing from the aspects of the signals sighted whether or not they are gaining or losing on the train in front and knowing also that from such speeds there is adequate braking distance should a " single-yellow " be sighted. Those are examples of the advantage taken of modern signalling to keep trains on the move.

In view of the deep significance attached by drivers to the difference between the " single-yellow " and the " double-yellow " on routes where they are continuously installed, and the operating advantages derived from it, we feel that it can only be a matter of time before some differentiation is called for in the audible cab signals of the new standard A.T.C. system. In this respect it is perhaps significant that the British railway with by far the longest and most extensive experience of A.T.C., had in mind, prior to nationalisation, some new works, including four-aspect colour-light signals, and to operate in conjunction with these the standard system of A.T.C. and cab signalling was adapted to give a different audible signal for " yellow " and " double-yellow." We described this system in our issue of November 14, 1947, but it is not clear at the moment how the inductive system proposed as the standard for British Railways could be extended to provide the same additional facility, if at any time such extension should prove to be desirable. We feel that the possibility of adding to the proposed standard system should be given serious consideration at this early stage. There is one last point we would make, and although it lies in rather a different direction it certainly forms part of the general interest, not to say anxiety, on all matters concerning A.T.C. at the present time. The Railway Executive has, in certain aspects of its work, been very frank in publishing results of tests on Regional and standard equipment, especially in the case of steam locomotives. In view of the widespread public and technical concern over A.T.C., at the present time, it would be of great interest if the Executive could publish full results of the tests on existing equipment, so that engineers could appreciate fully the reasons why neither the L.M.S. inductive system nor the well-tried Great Western contact systems were acceptable for installation on a national basis, and lengthy experiments had to be made on something that is new and untried.

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## Engineering and Food Preservation

In a memorandum issued at the end of last week, the Department of Scientific and Industrial Research has emphasised the importance of engineering research as it affects food preservation. It says that agricultural engineering is now a recognised branch of the profession, and it is becoming increasingly realised that the agricultural engineer has just as important a task as the biologist or the chemist in increasing food production. On the other hand, food when grown has to be preserved or processed and the prevention of waste and spoilage is almost as important as production. In this field the work of the biochemist and bacteriologist is recognised, but the activities of the engineer in food processing and preservation receive scant attention. Research on these problems began in this country during the 1914–18 war. Until 1939 the prime need in food preservation was for more bio-chemical and bacteriological knowledge. In many respects refrigeration practice had run ahead of scientific knowledge of the behaviour of foodstuffs during freezing and cold storage. During this period techniques in this field were greatly improved as a result of research, the carriage of fruit and meat from overseas being notable examples. The adoption of new processes such as dehydration, quick freezing and low temperature cold storage was greatly accelerated by the second world war. The lack of the kind of knowledge needed to turn laboratory experiments into industrial processes was then all too apparent. With a few notable exceptions, design of equipment is empirical or traditional.

Very few data exist upon which rational design of food processing plant can be based. The designer of equipment for food processing and preservation must not only have the necessary mechanical and chemical engineering knowledge, but must understand the biochemical considerations governing the process. Research and development work is largely a matter of discovering the limits of the process variables within which the specifications laid down by the food scientist can be met, and of providing data to enable the designer to choose the optimum conditions within those limits. Fundamental researches in such fields as heat and water transfer also have to be undertaken. For instance, biochemists have laid down that in order to retain initial quality in frozen fish, the freezing time must not exceed a certain limit. The engineers have not only to define the limits of shape, thickness and surface heat transfer rate which will produce this result, but have to investigate the effect of refrigerant flow rate, turbulence, viscosity, &c., on the heat transfer coefficients, and must also explore the mathematics of heat flow in freezing bodies. Since the war, research engineers have joined several organisations dealing with food processing and preservation. The Research Association of British Flour Millers and the British Food Manufacturing Industries Research Association now have engineering research staff, as has the National Institute for Research in Dairying at Shinfield and the Ditton Laboratory at East Malling. Several of the larger firms, and the Ministry of Food experimental factory at Aberdeen have also recruited research engineers.

The D.S.I.R. memorandum goes on to say that perhaps the most notable advance in this field is at its Torry Research Station. Among the contributions which the engineering research and development section has contributed is a vertical plate freezer, specially developed to freeze the early part of the catch on board existing trawlers. Other activities in the six years of the section's growth have been the specification of a new trawler for the station and the design of a new set of experimental cold stores. The trawler is the first diesel-electric vessel of its kind and the cold stores incorporate many innovations, including jacket cooling. A new building to accommodate the research on quick-freezing and cold storage is being erected at Torry, and a well-equipped engineering workshop is already in being. Besides the problems mentioned, the long-term programme at Torry includes a study of cold store design with special reference to humidity, the study of heat leak into trawler's holds, development of improved materials and equipment for trawlers' holds and the development of gutting machinery for white fish.

The memorandum stresses that the promotion of physics and engineering research in food preservation is clearly a matter of real importance to the Government.

# THE DELTA CONFIGURATION AT FARNBOROUGH

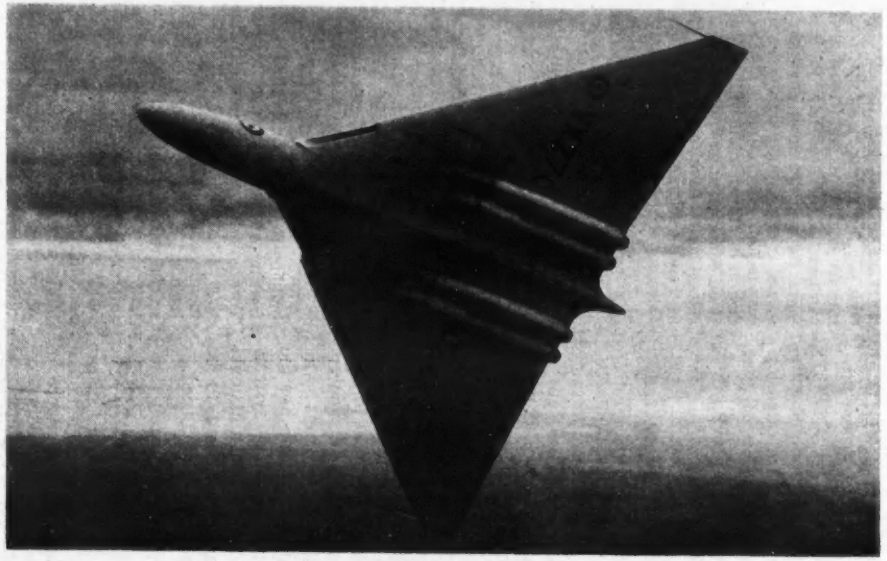


Fig. 9—The Avro "Vulcan" in a Climbing Turn

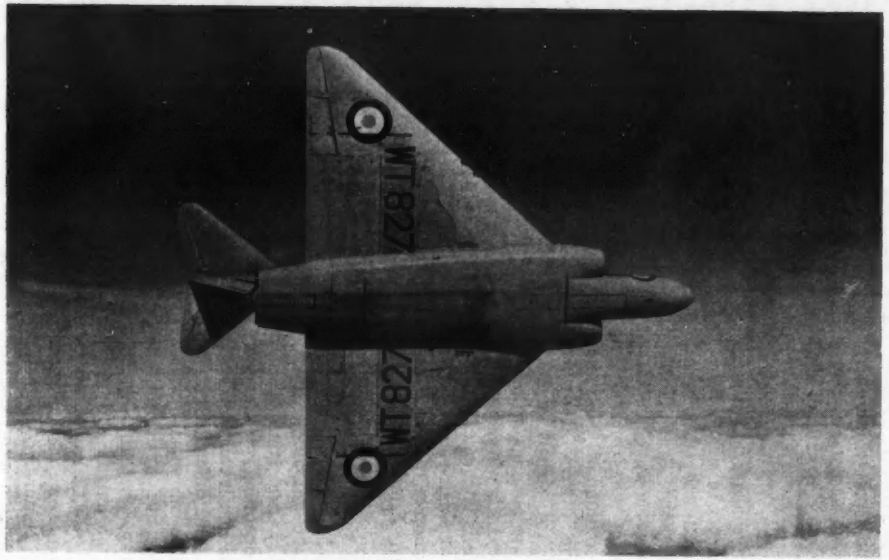



Fig. 10—The Gloster "Javelin" Radar Fighter

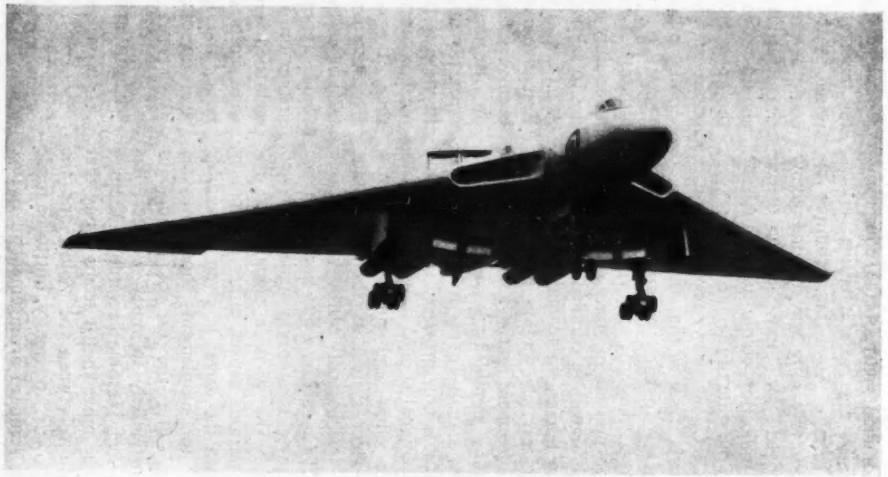


Fig. 11—The "Vulcan" Showing Air Brakes During Approach

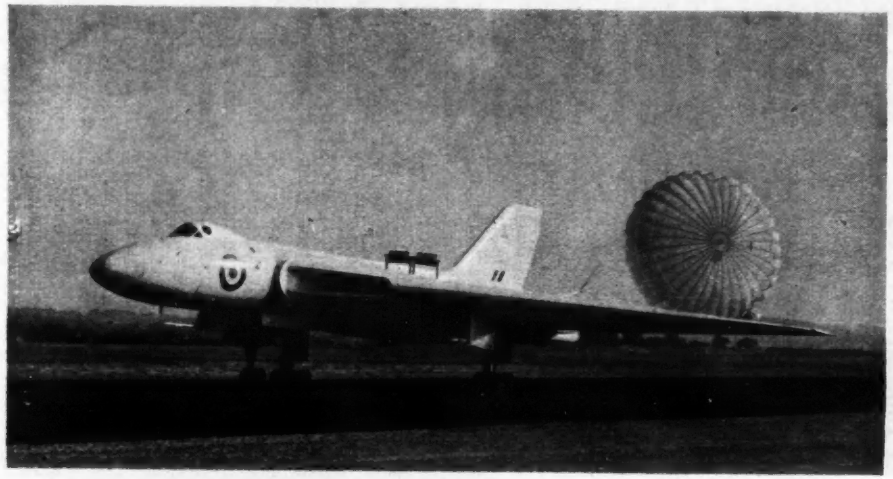


Fig. 12—The "Vulcan" Using Parachute Arresting Technique

# The S.B.A.C. Flying Display and Static Exhibition

No. II—(*Continued from page 310, Sept. 4th*)

AT the airport associated with the Royal Aircraft Establishment, Farnborough, there is once again being staged the exhibition of flying machines and aeronautical equipment which is arranged annually by the Society of British Aircraft Constructors. The arrangement of the static exhibition follows normal practice with a single marquee covering 11,000 square feet to enclose the stands of over 240 exhibitors. At least fifty-three aircraft can be inspected in the aircraft park. Thirty-six of these aircraft participate in the flying demonstrations each afternoon, with the exception of Thursday, on which day that singularly British achievement—the gas-turbined airliner—alone was demonstrated with some other more conventional civil aircraft. The exhibition concludes on Sunday, September 13th, and from to-day onwards is open to the general public.

Fig. 13—The Vickers "Valiant" B II Bomber

Last week we described briefly some of the gas turbines exhibited. Before continuing our account of that section of the exhibition we begin now with a few notes on some of the military aircraft displayed.

It might be justly claimed that one of the most unusual and outstanding spectacles ever staged at these annual displays is provided by the formation flying of the six delta aircraft made by A. V. Roe and Co., Ltd. It will be recalled that in previous years mention has been made of the displays provided by the Avro "Type 707" aircraft, whose triangular configuration contrasted so strangely with existing craft. First, came the small prototype "707B" in 1950, one of which so shortly crashed; the following year came the "707A," slightly larger, having a span of 34ft 2in and 42ft 9in long, with wing root intakes to eliminate the turbulence associated with the dorsal intake of the original design.

It was said to be associated with research in the higher speed range, but for what purpose these aircraft were being developed was not revealed until the "Vulcan," with four Rolls-Royce "Avon" turbo-jet engines (Figs. 9, 11 and 12) made its first appearance last year, when it became apparent from external view that all were geometrically similar. Since then the "Vulcan" has been under super-priority production and last week it was announced that a second machine had been successfully flown, this time with four Bristol "Olympus" turbo-jet engines.

Thus, it came as a fitting climax, although possibly only to the first stage in the evolution of the delta configuration, that four of these small prototypes should formate like small sleek parasites upon the great bomber versions whose form they had done so much to establish.

The "Vulcan" has neither tail planes nor flaps, yet it is claimed by the manufacturers to handle as readily and as safely as aircraft of the pre-war era. Neither dimensional nor performance figures may be quoted for this machine, but it is interesting to note that the civil project which the company has in mind using the same thrust could have an all-up weight of 200,000 lb, a cruising speed of 600 m.p.h., and fuel for flights in the region of 4000 miles.

The Gloster "Javelin" radar fighter (Fig. 10) is another delta aircraft made by the Hawker Siddeley Group of Companies and likewise owes much to the original development of this configuration by the "Type 707" prototypes. It first flew in December, 1951, and the arrangement of its two A.S. "Sapphire" turbo-jet engines is well shown in our illustration. This machine is fitted with very comprehensive electronic interception and navigational aids, very assuring claims are made for its manœuvrability, range and altitude, and it is said to be capable of supersonic speeds. Its low speed characteristics and manœuvrability are well demonstrated, but although its high-speed runs were much faster than those of previous years, no attempt is made to extend the aircraft in this respect. One of the principal differences between this and the other delta aircraft is the retention of a tail plane and elevators, which also have a delta configuration.

The two other jet bomber configurations, which, like the delta, are being evaluated in this country, but likewise have super-priority status (in respect of limited production orders), belong to the Handley Page "Victor" (Fig. 14), and the Vickers "Valiant." Both these aircraft employ a wing which is somewhat similar in so far as it has deep sharply swept wing roots of relatively large root chord and almost entirely enveloping the four turbo-jet engines. Their complete configurations, however, are quite different. The "crescent" wing of the "Victor," as its wing form is so called, has its sweepback and thickness progressively reduced towards the tip where it becomes almost straight, whereas outboard of the root section the "Valiant" employs a sharply tapered wing with a fixed leading edge sweep angle. It is not proposed here to reiterate the grounds upon which each of these three configurations is advocated by its designers. It is generally believed, however, that all these wings, which house fuel, engines and undercarriage without giving anything in low thickness/chord ratio considerations for high-speed cruising, have

Fig. 14—The Handley Page "Victor" Bomber

lower wing loadings than the very thin straight swept wings favoured by the Americans and all exhibit better stability and low speed handling characteristics.

Last week the first of the "Valiant" Mk. 2 series flew (Fig. 13). This is now powered by "Avon RA 14'" engines. It is also significant that the single-tandem wheeled main legs with outboard wing retraction has now given way to a conventional form of twin-tandem bogie retracting rearwards, the housing of which extends aft of the trailing edge.

### Aircraft Engines

Last week we described several of the gas turbines which are displayed in the static exhibition and the notes on the following engines continue our report of this section of the display.

The "Nomad 2 (NN.m6)" 3135 e.s.h.p. compound diesel engine which is being shown by D. Napier and Son, Ltd. (Fig. 15), has

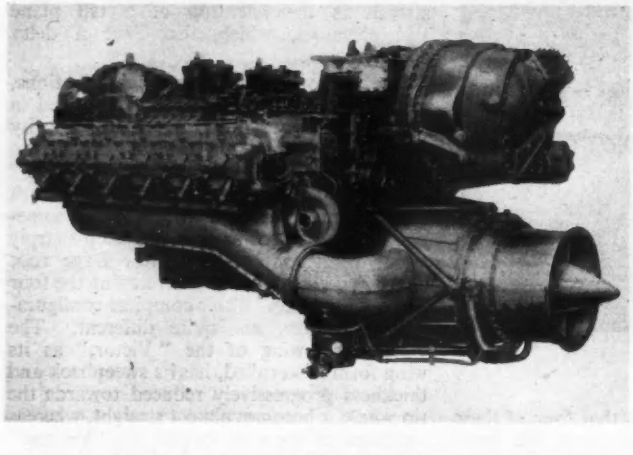


Fig. 15—The Napier "Nomad" 3135 e.s.h.p. Compound Diesel Engine

easily the lowest fuel consumption of any aeronautical engine built—its cruising consumption of 0·33 lb per equivalent shaft horsepower per hour comparing with the next lowest, 0·38 lb per equivalent shaft horsepower per hour, of the American Wright turbo compound double-row radial engine which has a static rating of 3500 h.p. and a specific weight of 1·10 lb per horsepower approximately. On the other hand, the "Nomad" has a larger frontal area and a specific weight somewhat greater than most double-row radial engines. As against one of the better turbo-propeller engines in the same class, its frontal area of 19·25 square feet and specific weight of 1·14 lb per equivalent shaft horsepower compares with 8·5 square feet and 0· 74 lb per equivalent shaft horsepower.

This engine has been considerably simplified since it first ran. Its mounts twelve horizontally opposed cylinders forming a two-cycle compression ignition engine. This unit is compounded with a turbo-compressor set mounted below the diesel unit. It consists of a multi-stage turbine, driven by the diesel exhaust gases, and an axial compressor which supercharges the diesel unit, the set being coupled mechanically to the reciprocating engine through gearing mounted above the turbine at the tail end of the installation. Power from the crankshaft and the turbine is thus transmitted to a single propeller shaft from reduction gearing at the nose end of the assembly. The fuel consumption of this engine is characteristically insensitive to part-load conditions and over a wide range of altitudes and speeds the consumption remains between 0·33 lb and 0·35 lb per equivalent shaft horsepower per hour. It is also stated to run equally efficiently on kerosene, diesel fuel or wide-cut gasoline.

In the present revolutionary phase through which the helicopter is passing, the gas turbine is already asserting a marked influence both in the form of auxiliary forward thrust from wing-mounted units and in the method of rotor propulsion.

Conventionally, helicopters have a radial engine in the fuselage with a vertical drive to the rotor. This drive is of necessity somewhat complex and heavy and is by no means cheap. Tip propulsion of the rotor is an alternative for certain purposes and, in considering various forms of units, one firm, the Saunders-Roe Helicopter Division, has decided that the most promising is the pulse jet. Some work has been done on this form of unit in this country but has not led to its application to aircraft propulsion, although it is known that the pulse jet unit has been developed and flown in the United States of America and it was the power unit of the German "V.1" missile.

Saunders-Roe, Ltd., commenced its experiments with pulse jets last year and has developed a unit giving 45 lb of thrust. This unit has now run many hours on test. The company is now proceeding with the development of a larger model designed to give 120 lb thrust and this can be seen running at its helicopter division at Eastleigh airport, near Southampton. The 45 lb unit is the one exhibited on the company's stand and is illustrated herewith (Fig. 17).

It will be recalled that the operation of a pulse jet engine is similar to a two-stroke internal combustion engine, with the piston replaced by a column of air and an automatic inlet valve at the combustion chamber head. A mixture of fuel and air is injected into the chamber and ignited by a spark. The resulting explosion forces the air column to the rear, thereby creating a thrust and allowing the exhaust gases to escape from the chamber in the familiar power and scavenge process of the two-stroke cycle. The exhaust gases are rejected so rapidly that the depression formed in the chamber induces a fresh charge of air to flow through the automatic inlet valve into the chamber where it is enriched with fuel. The air piston then returns and in compressing the mixture, closes the valve. Thus, since the mean temperature of the mixture is high, spontaneous ignition occurs and the cycle repeats itself *ad infinitum*.

The cycle's frequency is determined by the acoustic properties of the chamber, which for a given chamber configuration and operating temperature will respond to a fixed resonant frequency. The 45 lb unit operates at a frequency of 120 c/s, but this may be varied, according to chamber design, to a figure of over 200 c/s, or as low as 46 c/s, as with the German "V.1." The length of

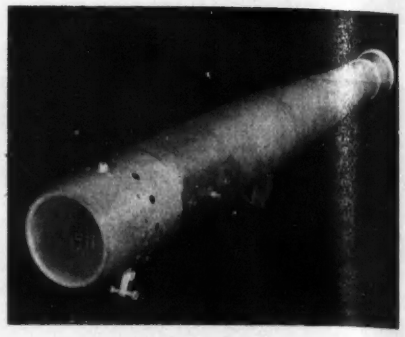


Fig. 17—The Saunders-Roe 45 lb Thrust Pulse Jet Unit

the unit is 47·5in its maximum diameter is 5·5in and it weighs 15·5 lb.

Apart from the development of reheat equipment which is now considered an essential component of military turbo-jet engines, the rocket and rocket motor have also been intensively developed in recent years largely as a means of thrust augmentation. In the former method additional fuel is burned after the turbine so raising the normal velocity of the effluent in conjunction with a variable jet pipe orifice as to increase the normal static thrust of the engine by as much as a third, and although this part of the overall cycle has a low thermal efficiency the additional thrust is obtained by hardly increasing the weight of the engine. Its advantages, however, are particularly worthwhile at great altitude where the ratio of reheat thrust to the reduced engine thrust is much greater for the same relative fuel consumptions.

The rocket motor has two distinct appli-

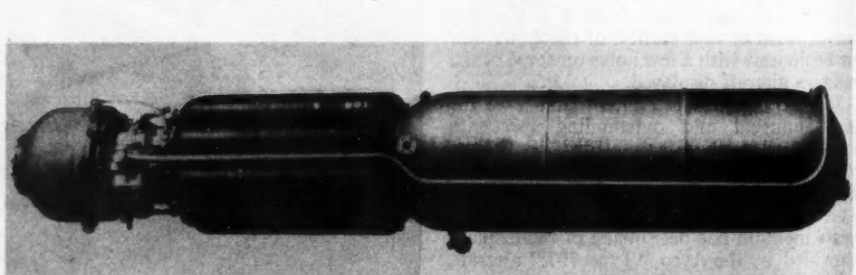


Fig. 16—The de Havilland "Super Sprite" Rocket Motor

cations which depend upon one or the other of its major characteristics and govern the form which the unit takes. The advantages of the unit for one application stem from its extremely high thrust per weight ratio and its small dimensions. The modern high-performance aircraft, whether jet or propeller driven, is capable of carrying in the air a far greater load than it is able to lift off the ground even from the longest runways. The availability of a rocket motor, with a power-weight ratio greatly in excess

of that of conventional power plants, providing additional power during the critical period, largely overcomes this handicap and enables the aircraft to take-off safely with greatly increased loads. For this application the unit can be entirely independent of the aircraft's main power plant and has a short duration commensurate with requirements.

The "Super Sprite" unit (Fig. 16) shown by the de Havilland Enterprise, is in this category. It employs hydrogen peroxide with kerosene or petrol injection and an important new detail is the solid catalyst which replaces the liquid potassium permanganate used in the earlier "Sprite" rocket motor. The purpose of the catalyst is to break down the hydrogen peroxide into water, in the form of steam and free oxygen, thereby providing the bulk of the thrust of the motor. The injection of kerosene or petrol fuel and its combustion, which is made possible by the presence of the free oxygen in the exhaust stream, increases the energy exerted by the rocket and this additional energy can be used either to increase the thrust or to extend the duration of the run. The kerosene or petrol used in the "Super Sprite" is drawn from a tank which is integral with the structure of the rocket motor. The de Havilland company maintains that hydrogen peroxide has a marked advantage over other oxidants in respect of its safety, handling and long storage characteristics. The introduction of a solid catalyst eliminates the need for a separate permanganate tank and leads to a simplification in design and operation, and it also eliminates the "brown steam" exhaust of rockets using permanganate.

The "Super Sprite" in its present form has a total impulse of 120,000 lb per second. It weighs 600 lb, develops a maximum 4000 lb thrust and has a duration of 40 seconds.

*(To be continued)*

## Technical Reports

### PERFORMANCE TESTS ON RIPSAWS

*The Performance of Circular Plate Ripsaws.* Forest Products Research Bulletin No. 27. London: Her Majesty's Stationery Office, York House, W.C.2. Price 1s. 9d.—This report deals with tests undertaken at the Forest Products Research Laboratory, to obtain information on some of the factors affecting saw performance. The tests were carried out to determine the effect of such factors as feed speed, depth of cut, tooth shape and number of teeth on the operation of circular sawing. A special study was also made of the behaviour of sawdust in the gullet area, a stroboscope being used for direct observation of the saw in action. High-speed photography was also used in this work.

All the tests except one were carried out on a standard 26in hand feed sawbench which was equipped with a variable feed gear so that any speed between 20ft and 150ft per minute could be used. A dynamometer type watt-meter was used to check the power input to the 10 h.p. driving motor under various operating conditions. Kiln dried timber with a moisture content of 12 per cent was used and successive saw cuts were made along the length of the samples. The woods used included poplar, Californian redwood, wych elm, beech, lime, and oak.

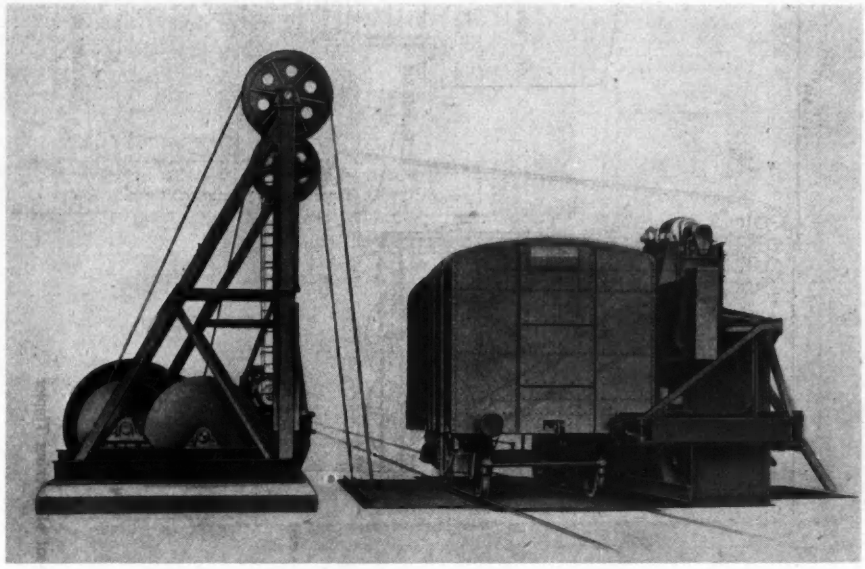
The Bulletin describes the test equipment and the general method adopted in carrying out the tests. Each test is described in detail and the result recorded. The tests included the effect of feed speed on power; the effect of depth of cut on power; brake tests on sawbench; effect of depth of cut on power and feed resistance; effect of the number of teeth on power and feed resistance; and the performance of saws having teeth of long pitch.

INTERNATIONAL RADIOCOMMUNICATIONS.—The seventh plenary assembly of the International Radio Consultative Committee was opened in London on September 3rd, by Earl De La Warr, H.M. Postmaster General. More than 300 delegates from about fifty countries are taking part in the proceedings, which will probably last until early next month. The business of this assembly is to study various technical radio questions with the object of securing efficiency in the use of the radio-frequency spectrum.

# End Rocking Tipplers for Railway Wagons

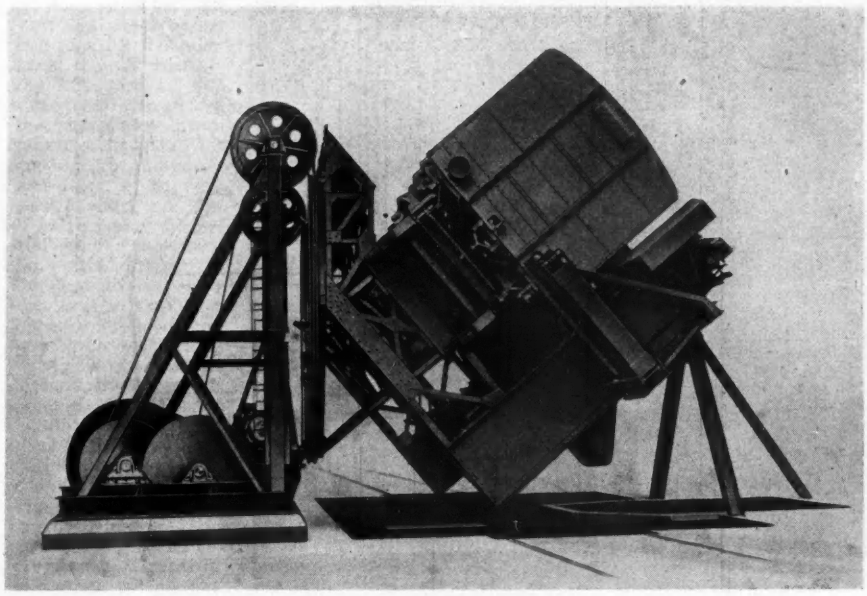
*A new design of end rocking railway wagon tippler was developed and three were built by Strachan and Henshaw, Ltd., Bristol, for handling box-covered wagons at the Sindri fertiliser plant in India. These tipplers are designed to tilt and give a fore-and-aft rocking movement to discharge all the contents of a wagon through its side door in a rail-to-rail cycle time of some three minutes.*

WHEN the materials handling plant was being designed for the large fertiliser factory opened at Sindri in India last year, a particular unloading problem arose owing to the fact that box covered wagons with side doors were to be used for the transport of bulk raw materials to the plant. Open trucks which could be handled by normal tippler equipment could not be used as the same vehicles were required for taking the finished products—fertilisers and cement—away from the factory, and it was necessary to protect these products from climatic conditions during transit. Although it would have been possible to resort to manual unloading with the large amount of labour available in India this means was not considered desirable for a number of reasons. It would have entailed amongst other things, the laying down of a much greater length of unloading sidings, a considerable increase in the number of transport vehicles in service and an extensive belt or other collecting system to take the materials to disposal points.

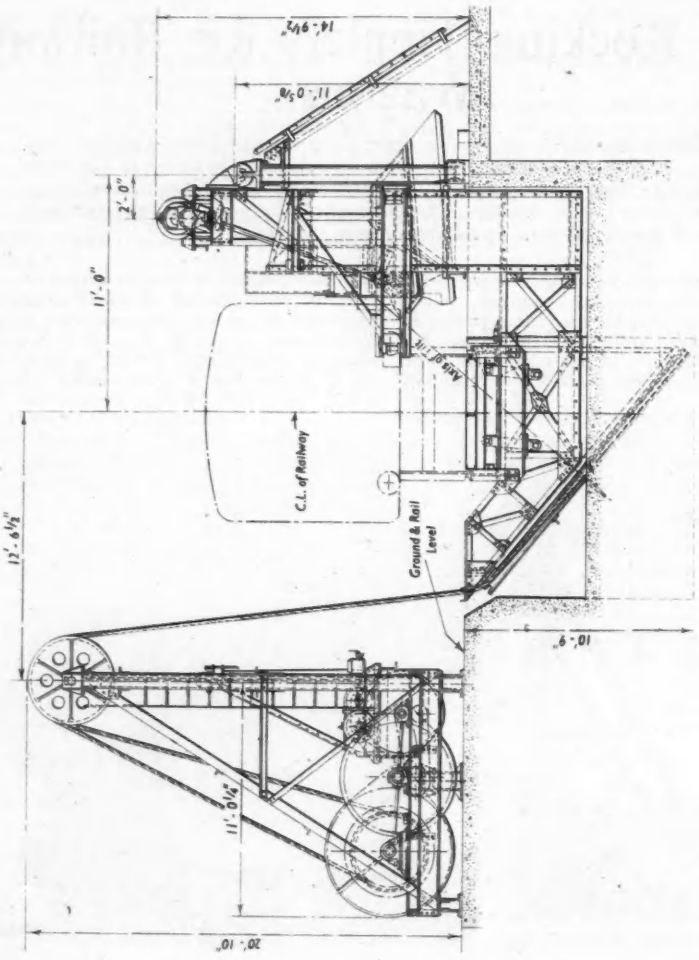


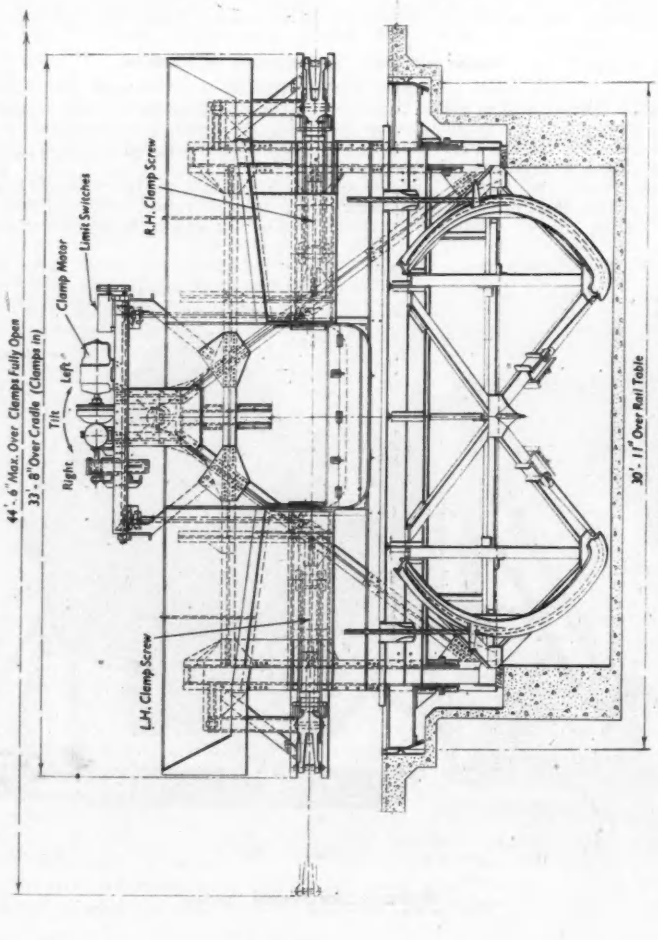
Tippler with Full Wagon Clamped on Platform

At the time the problem was being considered no suitable tippler was available which would tip a box wagon through a sufficient angle and



Platform in Side Tipping Position




Arrangement of Rocking Tippler

rock it end to end to eject all the contents, which might be coal, coke or limestone in all sizes.

The main contractors for the project, the Power Gas Corporation, Ltd., Stockton-on-Tees, asked Strachan and Henshaw, Ltd., St. Philips, Bristol, 2, a firm which has specialised in the design and manufacture of wagon tipplers for many years, whether an equipment to meet the particular requirements was a practical proposition. A satisfactory design, now known as the "end-rock" tippler, was developed and three units were built and installed by the firm. These tipplers were mentioned briefly in our first article on the Sindri fertiliser factory which appeared in the issue of March 7, 1952.

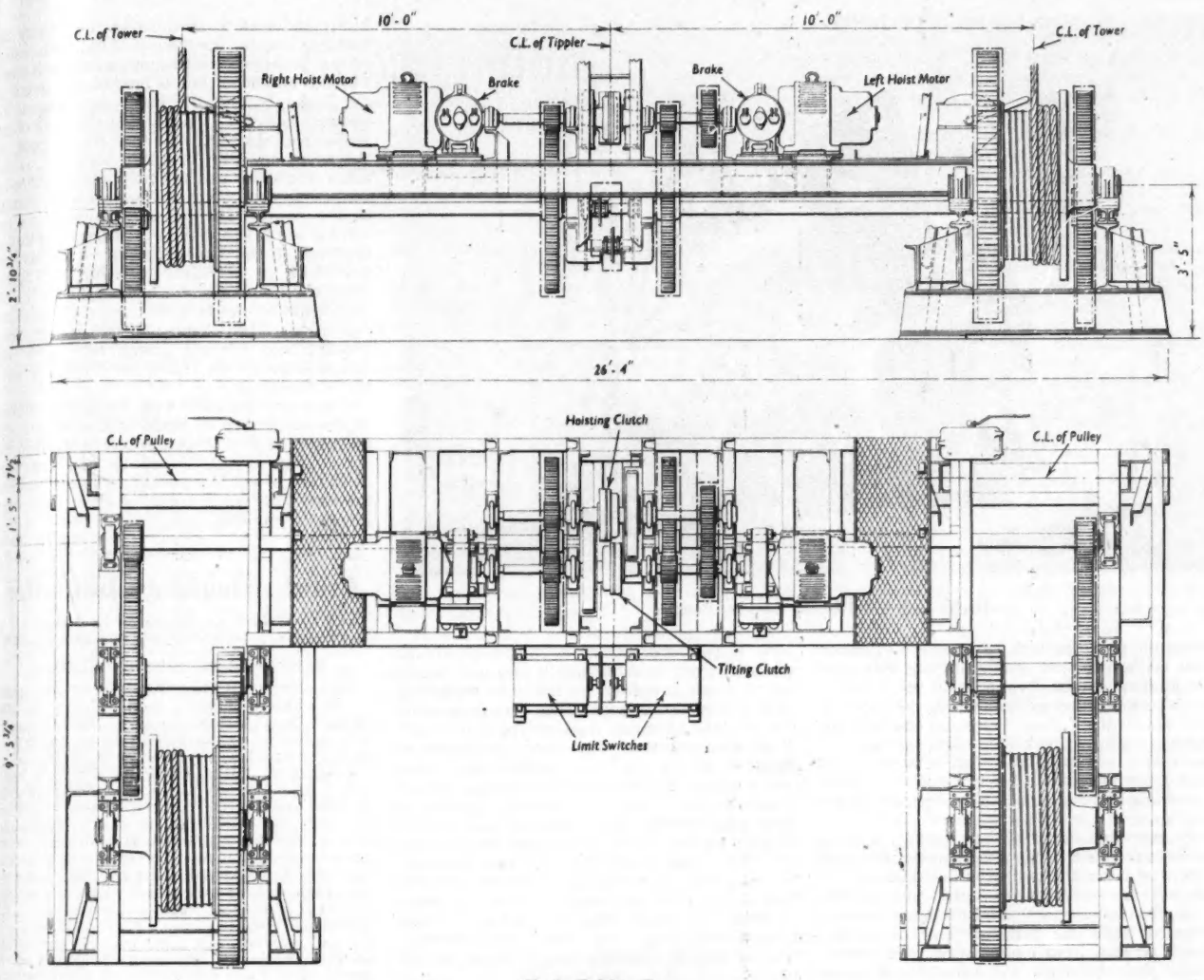
As these tipplers are believed to be the first mechanical means of their kind to be developed for the complete unloading of box covered wagons through their side doors and they have applications elsewhere in the world, we recently took advantage of a visit to the works of Strachan and Henshaw, Ltd., to obtain further details of the design and construction of the tipplers. It should be mentioned that the tipplers are installed in sheds in such a way that conditions are not suitable for the taking of clear photographs showing the operation of the machines; for this reason two of the illustrations used have had all of the background removed for purposes of clarity. The two other photographs show a tippler in operation before and after its shed was erected.

The sequence of operation of an end-rock tippler can be seen in the accompanying illustrations. A wagon is run on to the platform and arms at each end swing inwards to grip the inner buffers and lock the wagon on the platform during subsequent movements. After the appropriate side door has been opened the platform swings up to an angle of 50 deg. for the wagon contents to slide out on to a chute down which they gravitate into an underground hopper. In this first movement the material in the centre of the wagon is discharged. The platform is then tilted endwise up to an angle of 45 deg. for the contents at one end to be cleared through the door. In the next movement the wagon is rocked back through 90 deg. to discharge the contents at the opposite end. A subsequent movement through 45 deg. brings the platform back on an even keel after which it is lowered back to rail level for the wagon to be run off.

The actual emptying cycle takes only 190 seconds, and to give the specified minimum rate of discharge of ten wagons an hour just under three minutes are available in each cycle for empty wagon removal and replacement by a full wagon. Under favourable working conditions it has been found possible to unload up to twelve wagons an hour. Once the wagon is positioned and clamped on the tippler platform all movements are controlled by the operator using a directional joystick control lever.

The construction of the tippler can be seen in the drawings we reproduce. Its tipping platform assembly has at the rearmost side a heavy rigid frame consisting of two vertical members built up of reinforced steel sections and coupled together by cross members. A heavy beam forming one of the frame cross members is fitted with rubbers on its inner face and serves to support the side of a wagon during the tipping movement. A deep plate placed above this support incorporates a central chute into which the wagon contents are deposited in the tipping operation. At the top of the frame and rigidly supported by inclined members is a heavy steel bracket casting and the part of this bracket projecting rearwards and downwards is machined to form the ball half of a ball-and-socket universal joint.

Steel lattice beams projecting from the bottom of the rear frame carry the platform and rails. The longitudinal members of this assembly on which the rails are carried are, in the usual way, supported on links so designed as to swing as a unit and allow a wagon to lean over against the side support member of the frame during the tipping operation without the wheels leaving the rails. Near the ends on the outer side of the platform are two lattice beams which are set at an angle and rigidly support a structure on which are mounted two specially shaped guides or fixed pulley units for the hoisting ropes. The whole of the platform assembly fits into a pit




**Tippler Driving Gear**

below rail level, and when the tippler is in the wagon loading position its weight is supported on pads let into the foundations.

A structural steel tripod assembly at the rear of the tippler has at its top a steel casting machined to form the socket half of the universal ball joint mentioned above. Two heavy structural steel columns at the front of the tippler carry the head pulleys of the platform tilting gear, and the driving gear itself is assembled on the girder base of these columns. From a large drum at the base of each column ropes are carried over the head pulleys, round the platform pulley tracks, and their ends are locked in blocks on the diagonal platform members.

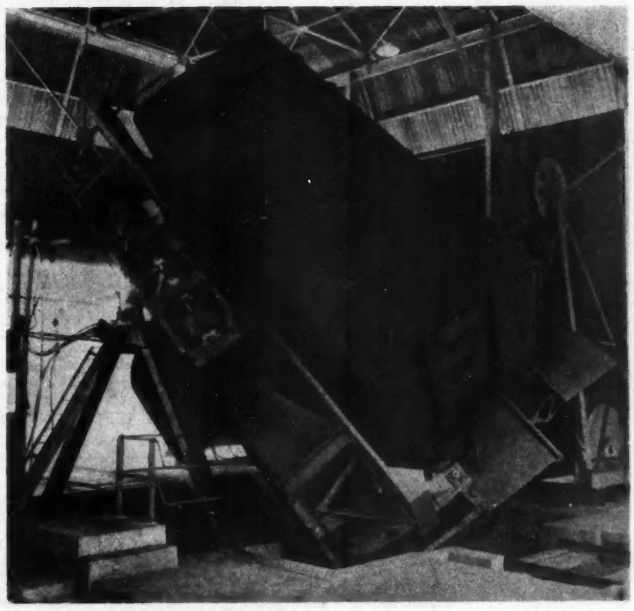
It will be clearly seen that, as the two ropes are hauled in to raise the outer side of the platform, the platform is supported at two points at its front and at one point on a universal ball joint at the rear. With the platform tilted to its maximum angle all that is required to rock it is to operate the ropes first to raise one end as the other is lowered and then to reverse this movement.

The arrangement of the tippler driving gear can be seen on a drawing on this page. It consists of two interconnected rope hoist units each driven through spur reduction gearing by a 30 h.p., 725 r.p.m., reversible electric motor. The drive and gearing are arranged to give a constant rope speed of 25ft per minute. When the platform is being tilted to its first discharging position by hauling in both ropes the two motors run in an anti-clockwise direction. A magnetic clutch which is automatically engaged at the outset of this operation couples the two sets of gearing so that they work in complete unison. When the full required angle of tilt is reached a limit switch comes into effect to stop the motors and apply electromagnetic brakes fitted to each of their shafts.

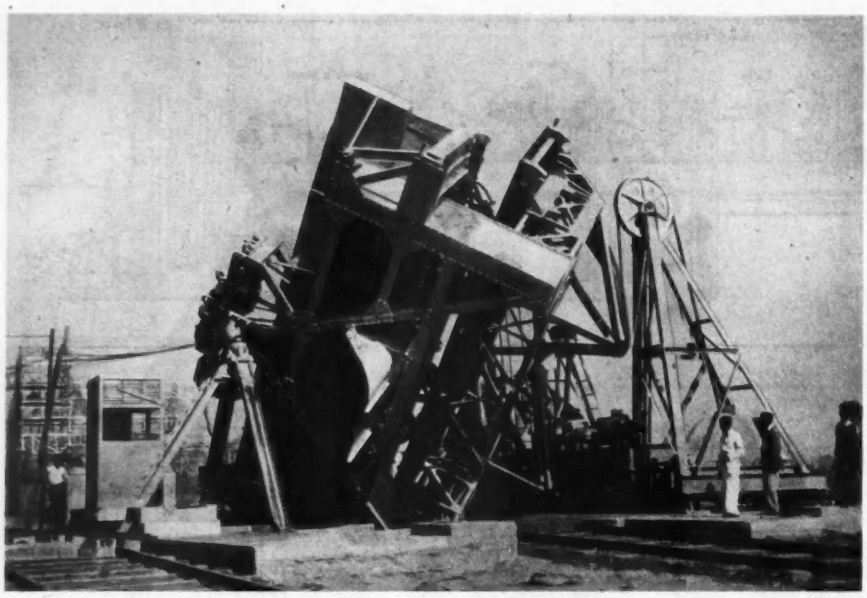
With the platform suspended in this position, if the operator wishes to rock it, say, first to the left, he pushes the control lever in that direction. The direction of rotation of the left-hand motor is then reversed to clockwise and, at the same time, solenoids come into effect to bring intermediate gears on the left-hand side into mesh. The drive of the two motors is then transmitted through this gearing and a second magnetic clutch known as the tilting clutch. The hoisting gear thus continues to act as a single unit, but with one drum paying out rope as the other hauls it in at precisely the same speed. Full three-point support of the platform is maintained throughout the end tilting movement and there is no rope slack at either end.

At the end of the first end tilting movement limit switches again cut out the motors and apply the brakes until the operator pulls his control lever over to the right-hand tilting position. Then the solenoids holding the left-hand intermediate gears return them to the inoperative position and similar solenoids on the right-hand bring another set of intermediate gears into position. The anti-clockwise direction of rotation of the left-hand motor is restored and the direction of the right-hand motor is changed to clockwise whilst the tilting clutch is again engaged to consolidate the drive. The two motors start up and the two rope drums turn in the opposite direction to tilt the platform towards its opposite end.

At the end of the tilting movement the operator



**Tippler Installed and in End Rocking Position**



Tippler Under Test in End Rocking Position

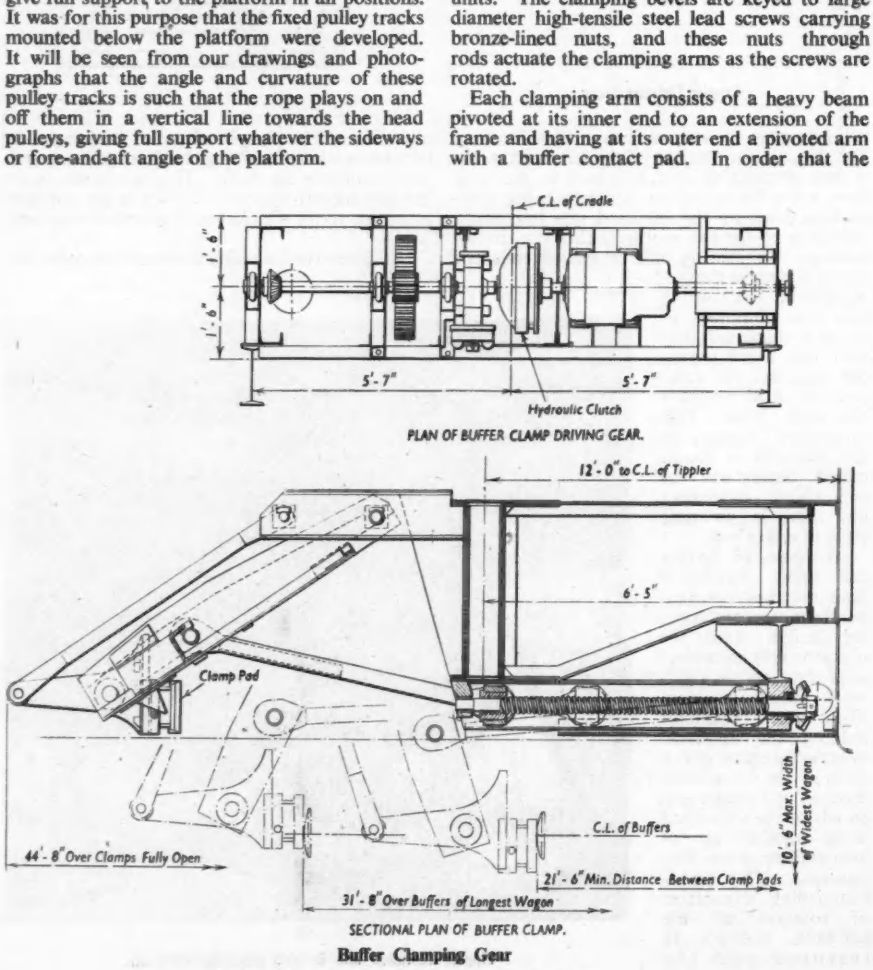
brings the platform back by putting his control lever in the left-hand position till the two ends are level, and then returning the lever to its central inoperative point. When the lever is then put in the "lower" position the hoisting clutch is engaged and both motors start up and run in the clockwise direction. As the platform comes to rest on its pads the motor current is automatically switched off to prevent rope overrun.

An important factor in these operations is to maintain the track of the ropes between the head pulleys and the platform truly vertical and to give full support to the platform in all positions. It was for this purpose that the fixed pulley tracks mounted below the platform were developed. It will be seen from our drawings and photographs that the angle and curvature of these pulley tracks is such that the rope plays on and off them in a vertical line towards the head pulleys, giving full support whatever the sideways or fore-and-aft angle of the platform.

As already mentioned the wagons are held on the platform by mechanically operated clamping units which register on the inner buffers at each end of the wagons. The arrangement of one of these clamping units can be seen in the drawing on this page. The clamp driving gear is mounted on the top of the tippler side frame and is driven by a 30 h.p. motor through a fluid coupling. A pinion on the clutch shaft drives a large gear mounted on a shaft, at each end of which is a bevel wheel. From these bevel wheels the drive is transmitted through diagonal shafts to a second set of wheels on each of the clamping units. The clamping bevels are keyed to large diameter high-tensile steel lead screws carrying bronze-lined nuts, and these nuts through rods actuate the clamping arms as the screws are rotated.

Each clamping arm consists of a heavy beam pivoted at its inner end to an extension of the frame and having at its outer end a pivoted arm with a buffer contact pad. In order that the buffer pad shall at all times be square with the buffer of a wagon irrespective of its length (within certain limits), a parallel motion linkage is fitted. For this an anchor link is pivoted at one end to the frame beyond the buffer arm and at its opposite end to an extension at the back of the buffer pad support. By this arrangement, as the clamping beam is drawn forwards by the screw, the buffer pad assembly is kept in line by the anchor link which follows a course parallel to the beam. The hydraulic coupling in the drive is set to slip when a predetermined load is imparted to the wagon buffers. The clamping unit drive is interconnected with the tippler drive to ensure that when a wagon is on the platform it cannot be tilted until the clamps are operating. This clamping gear is such that, without need for adjustment, the tippler can handle wagons from 21ft 6in to 31ft 8in between the buffer faces.

The makers point out that, if required, tipplers of this design can be made with a weighbridge incorporated so that wagons can be weighed full and empty as they stand on the combined machine. It will also be clear that the machine can deal with mixed trains of closed and open wagons having side doors.




Buffer Clamping Gear

## British Standards Institution

*All British Standard Specifications can be obtained from the Sales Department of the Institution at 2, Park Street, London, W.1*

### ELECTRICIANS' RUBBER GLOVES

No. 697 : 1953. Price, Parts 1 and 2 together, 3s. 6d. This is a new edition. Unlike the 1940 edition it is divided into two parts : Part 1, dealing with gloves for use on live circuits up to 250V to earth, and Part 2, which deals with gloves for use on live circuits of 1100V, 3300V and 4000V to earth. This division into two parts has been made in order to emphasise the fact that, in general, work on live equipment above 650V to earth is at variance with the Electrical Regulations made in the Factories Act of 1937 and 1948 and cited as the Electricity (Factories Act) Special Regulations, 1908 and 1944. Both parts apply to gloves made either by a dipping process or from sheet rubber or from moulds. The specification gives guidance on the selection of gloves for test purposes and prescribes the appropriate electrical, mechanical and ageing properties of the gloves, together with their dimensions and the method of marking.

### SIZES OF SENSITISED PHOTOGRAPHIC PLATES

No. 1406 : 1953. Price 3s. In this revision of an earlier edition, the schedule of nominal sizes is unchanged, except for the addition of the 4in by 5in size and some sizes for photomechanical purposes. The tolerances on the cutting sizes for some of the larger plates have been reduced and an attempt has been made to solve the problem of checking the dimensions of plates by the introduction of a gauging procedure, involving a "Go" gauge (through which the plate must pass) and two "Not go" gauges (through which the plate must not pass), for checking each dimension in turn.

### ACCURACY OF CIRCULAR GEAR SHAVING CUTTERS

No. 2007 : 1953. Price 2s. This standard forms part of a series which will deal with gear forming tools. It applies to serrated circular gear shaving cutters having single or double cutting flanks. It specifies limits of accuracy only for such cutters, new or completely reground, when intended for production of gears of an accuracy comparable with Class A1 of B.S. 1807 : 1952, "Gears for Turbines and Similar Drives. Part 1 : Accuracy." The tolerances given are based on a specification prepared by the Mechanical Engineering Research Laboratory of the Department of Scientific and Industrial Research for "Accuracy of Gear Shaving Cutters for Marine and Similar Drives."

### MOULD DIE SETS FOR INJECTION MOULDING MACHINES

No. 2012 : 1953. Price 2s. 6d. The purpose of this standard is to provide a range of mould die sets for use with existing designs of moulding machines with a view to ensuring the maximum use of the platen area of machines and economical production of die sets. The relevant details of injection moulding machines which concern die sets have not yet been standardised ; it is expected that this will receive attention at a later date and this standard may then require review. It specifies dimensions, design and materials for use with injection moulding machines from 2 oz to 10 oz capacity.

# Fuel Conservation

*In January, 1952, a British specialist team was appointed under the auspices of the Anglo-American Council on Productivity to visit the United States and study the application and conservation of fuel, heat and energy. Its report was published last Monday, and we here print the "Summary and Recommendations" from that report.*

*A Critical Situation.*—The problem of conserving Britain's coal resources effectively without impeding industrial development or impairing the well-being of the people is of deep concern to the nation. Complex as it is, lamentably few appreciate its urgency. That the country's fuel position is difficult may be known ; it is certainly not generally recognised by the public that our coal resources, as limited as they are valuable, are being burnt up at a rate culpably prodigal and in ways the reverse of efficient. To us members of the fuel conservation team the fact is plain that a bad situation will grow worse unless the present unheedful drift can be halted. It is regrettable, notwithstanding the complexities of the problem, that there is not a wider public appreciation of the country's difficult fuel position and of the fact that in many directions we are using our valuable and limited coal resources inefficiently and at a prodigal rate.

Ordinary common sense would dictate that we should use our fuel resources wisely, avoiding all possible waste. We are not doing so, although the problems of fuel and power shortage have been continuously before us for more than a decade.

*Coal a Wasting Asset.*—We must face up to the fact that coal is virtually our only source of heat and energy ; it is too precious to permit of its profligate and wasteful use, even if it could be produced in great abundance and even if our reserves were vastly greater than they are. The real position is, of course, that the present level of coal production hardly suffices to meet our bare needs, while our reserves are definitely limited, particularly our reserves of coals of the higher quality essential for the carbonising industry.

Coal is, indeed, a wasting asset, and we have no choice but to conserve it in default of an alternative and lasting source of energy. It would be unwise to assume that any other form of energy will make a material contribution to the country's needs by replacing coal within, say, the next thirty years.

The difficulties of and limitations upon coal production in Great Britain are well known and do not come within the scope of this report ; we are concerned here primarily with the effective utilisation of the coal we do produce. It is a sad commentary upon our national intelligence that from all the hard-won coal we consume some 80 per cent of the heat is lost, a great deal of it because of ineffective utilisation. Wastage that is avoidable offers an affront to our current ideas of efficiency and stands as a challenge to the British technician.

It is a good omen that our technicians are becoming increasingly conscious of the mistakes we have made and are making. Shortage of coal and its high cost themselves provide a good and sufficient reason for improving fuel utilisation in every direction. The state of affairs will not grow less stringent. We must expect not a static but an ever-growing demand—the inevitable outcome of the increased mechanisation implicit in industrial progress.

It is an anomalous position that we have in Great Britain industrial units which compare in efficiency with the best in the world, while our general standard of fuel utilisation is perhaps the lowest of any industrial country in Europe.

*The Meaning of Fuel Efficiency.*—"Efficiency" in the use of fuel should not be regarded as meaning only thermal efficiency. It comprises the overall effect of methods of fuel utilisation upon the process as a whole, including labour costs, quality of product, rate of production, and so forth. Within this broad definition there is wide scope for economy through the adoption of good practice. It governs productivity.

By and large, British industry has not replaced or materially modified its fuel and power equipment since the first world war ; it is old and inefficient. But machinery that was perhaps good enough when coal was in abundant supply and cost as little as 10s. per ton at the pithead is not good enough to-day and remains an obstinate barrier to the achievement of real fuel economy. Much plant in this category has already reached obsolescence, but is not replaced for various reasons, principally the capital cost involved.

*The Heart of the Problem.*—Somehow this barrier must be removed ; an incentive must be provided to break the deadlock. This is the heart of the problem, and it turns on the financial predicament of industry at large. It is unlikely that industry will maintain and improve its standard of fuel utilisation unless it is actively assisted, persuaded or even coerced to do so by legislative means. Given inducement, the many plans and projects that have been developed, but perforce postponed, will be brought out of their pigeon-holes.

It is true that in many important industries the cost of fuel is a small proportion of total production costs ; but we should not condone inefficient fuel utilisation on that account.

*The First Line of Attack : Steam.*—Of all the directions in which fuel economy can be pursued in industry the usage of steam offers the most direct line of attack and might yield the greatest savings. Steam is perhaps the commodity most universally consumed in British industry, and perhaps the worst used, primarily because our traditional practice has been to divorce processing departments from engineering departments.

Too often, as things are, steam is on tap to operators who have no understanding of or regard for its cost, and who therefore use it without discrimination. Too often the works engineer, who knows, or ought to know, the cost of these services, has no jurisdiction whatever in the department or processes in which steam is consumed. His protests at its wasteful usage seldom fall on sympathetic ears, notwithstanding that for every 1 per cent that might be saved in its production 5 per cent or more might be saved in its utilisation.

It is this kind of traditional practice in industry which it is necessary to change, and change can come only from a better appreciation of the problem by executives.

The measures that can be taken to avoid the very heavy waste of steam in industry are well established and certain of them are dealt with in the report.

*The Co-operation of Industry.*—It would be wrong to convey any impression that industry had not co-operated in the drive for fuel economy carried on throughout the country since 1942, or that material results from that campaign have not been achieved. Indeed, it is true to say that without it we should not have had any real measure of efficiency in fuel utilisation, and that our general position would to-day be infinitely more difficult than it is. The campaign, too, enabled an assessment to be made of the potential value, and of the ways and means, of improving efficiency in all directions. It uncovered our weaknesses.

*A State Responsibility.*—We do not exclude the nationalised fuel industries from our recommendations, since we believe that they are the focal point of improved fuel utilisation. By taking control of the production of coal, gas and electricity the State has accepted responsibility for the fuel services. It cannot therefore stand aside and permit waste or improper use of these fuels to continue.

Politics apart, the fuel technologist has always felt nationalisation of the basic fuel industries to present great possibilities of substantial benefit, provided real co-ordination could be achieved between them. In the long term concern would be with such matters as :

Integration of gas and electricity production on the same site.

Generation of power from gasworks waste heat, and/or from an orthodox power plant using coke breeze, both supplying power to the grid.

Exploitation of the advantages of the gas turbine in the waste heat cycle.

Supply of pass-out steam and power from a generating station to a gasworks.

In the short term, many vexed questions await solution ; for example :

Is it in the national interest that electricity, a costly and refined product, should be used for space heating, except where gas is not available ?

Is it not essential, in view of industry's future needs for power, that the functions of electricity be confined to the provision of power, light and certain specialised heat processes ?

Is not gas the right fuel to retain on tap for space heating purposes (occasional heating) ?

Seeing that the base load of space heating can only be carried by solid fuel, is it not in the country's best interests that smokeless fuels be used, particularly in the domestic sphere ?

Can we produce more smokeless fuels, improve their distribution and reduce their cost ?

Where electricity is available, should gas lighting be used for public services ?

*Lack of Co-ordination.*—We see no evidence that any co-ordination whatever has taken place or even been attempted on either the long or short-term policies indicated above. On the contrary, we see each industry—coal, gas and electricity—consolidating its own policy and pursuing its own line of action, presumably because the wider national interest is none of its responsibility.

Within the Acts of Parliament, the responsibility for co-ordination lies with the Minister of Fuel and Power. Successive Ministers have apparently taken no action since nationalisation other than the setting up of the Ridley Committee in September, 1951. It is to be assumed, therefore, that they were uncertain where beneficial co-ordination might lie and how such co-ordination might be imposed upon or fitted into the framework of a national policy.

Until the publication of the Ridley report there was no basis upon which a Minister could act or a national policy be built unless it was considered that national interests were sufficiently well served and safeguarded by engendering competition between the fuel industries and promoting for the consumer "freedom of choice" of fuel.

But is there, in actuality, freedom of choice ? The economic principles of free enterprise have not applied in the fuel industries since nationalisation. Conditions have suspended their operation. Under shortages the law of supply and demand, in the accepted commercial sense, ceases to function ; under controls, the normal price mechanism is deliberately thrown out of gear. In such abnormal circumstances there is no such thing as healthy competition. Indeed, the influences work in the opposite direction.

The competition we are at present witnessing between gas and electricity for new housing services is the reverse of healthy from the national point of view. Yet one of the expected benefits of nationalisation was the elimination of wasteful competition between the two services. Co-ordination appears to be the only instrument to achieve it. The nationalised industries, being non-profit earning, are not stimulated by the profit motive. That being so, unregulated competition does not appear to be in the best interests of fuel conservation.

We see, for example, the gas industry continuing to compete for public lighting and the British Electricity Authority competing still more strongly for domestic space heating.

There can be no real freedom of choice for the consumer where fuel shortages and controls persist, and where prices are not in equilibrium with true costs.

Competition and freedom of choice are, in such case, false gods. They should be replaced by co-ordination and a national fuel policy.

*A National Fuel Policy.*—The Ridley report makes clear both the magnitude of the task involved and the problems that surround it. We join, nevertheless, with the great body of informed opinion in thinking that a national

fuel policy is essential to the future well-being of this country. We believe that such policy can be evolved only by patient and expert investigation, largely on the part of highly qualified technical men. Its purpose would be to impose a rigid check upon avoidable waste in every usage of heat and power and to bring about such measures of economy as will reduce to the minimum the amount of fuel consumed, without detriment to industry or to the public and national services.

*Task for a Commission.*—We suggest, therefore, that a commission be set up to this end, armed with full powers of investigation, not excluding the nationalised industries, and that its reports be published as White Papers.

It is clear that such a body, however assiduously it applied itself to the task, would be unlikely to promulgate its proposals within perhaps two years. In the meantime, the country is seeking guidance in these matters, as are all engineers, manufacturers of plant and appliances and professional men who are concerned with the many phases of this critical problem. The matter is urgent, and a strong lead is needed to end vacillation. This could be given without waiting for full development of a national policy.

*An Interim Declaration.*—It is felt, therefore, that when the commission is set up, the Government should make a declaration of intention to : conserve the coal resources of the country by all practical means ; use the coal produced so that we obtain from it the greatest value economically possible, and that it envisages the country's almost complete dependence on coal for the next thirty years ; the possible reservation of coals of high quality for special purposes ; the early cessation of open-cast mining and the retention of these reserves of fuel against future emergency ; high priority for all means of improving fuel utilisation in every direction ; the provision of incentives for industry to install efficient fuel-using plant* ; the immediate setting up of an industrial fuel efficiency organisation† ; expediting by all practical means the fuel economy measures to be taken by the nationalised industries, including transport ; abandonment of practices and processes which are inimical to good fuel economy ; that solid fuel, gas and electricity should each be used for purposes for which it is best suited, compatible with the best interests of the nation.

Procedure in the manner suggested may be unorthodox, but it should clear the air of uncertainty, and the country would respond once it realised that conservation of our coal resources really is of vital importance.

*Secondary Sources of Energy.*—The shortage of coal has naturally focused attention on secondary sources of energy such as water and wind power, the extraction of methane from coal mines and sewage sludge, underground gasification of coal, tidal power and, above all, atomic energy.

All these real or potential sources of energy do not alter our present dependence on coal. This fundamental fact must be thoroughly realised. The public should not remain befogged.

### Conclusions

We have endeavoured to show that there is no room for complacency on the question of fuel conservation ; there is certainly no satisfaction in the knowledge that we are by far the most inefficient users of fuel in Europe, although we have every reason to be the most economical. Let it be repeated that our supplies of fuel are growing less, that our carbonising industries are already concerned about the reserves of coking coal, and that the availability of sufficient energy for future industrial requirements is causing anxiety.

It has been stated already that 30,000,000 tons of coal per annum could be saved by reformed practices and better utilisation ; we know how to do this, we know that it will entail heavy cost and take time. But the reward is great. We must get on with the job.

Finally, we pose the questions :

Is it for the good of our coal, gas and electricity industries, or is it sound sense from a national point of view, that these industries should remain under the influence of party politics ?

Would it not be better to establish a simple, permanent and non-political fuel and power board to undertake the higher direction of these three national industries, composed of men best fitted for the job ?

Our legal system in Great Britain is acknowledged as a pattern for the world, and is above politics. Is it less important that our nationalised fuel industries, upon which our very livelihood so largely depends, should be accorded the same freedom from political sway ?

With the country looking for an authoritative line of action, we suggest one bold stroke to set us on the right road : enact legislation to create a permanent and non-political Fuel and Power Board. Let that board formulate whatever policy is necessary, but above all let it get on first with co-ordination.

Britain is rich in men of wide experience and of high moral and technical attainments, ready to subordinate their personal interests to the country's needs. We see no difficulty in forming such a Fuel and Power Board and in providing proper parliamentary liaison with it.

### Recommendations

Every means should be taken to inform the public of the serious fuel and power problems facing this country.

The Government should make an early declaration on the broad policy it intends to follow in regard to fuel and power.

The Government should set up a commission to formulate a national policy, and/or the nationalised industries—coal, gas and electricity—should be co-ordinated under a Fuel and Power Board.

Financial incentive should be provided to encourage industry to install efficient fuel-burning plant and equipment.

Top priority should be given to the production of plant and equipment to ensure the efficient use of fuel.

Traditional practices in works management which are inherently wasteful of fuel should be exposed and, where possible, reformed or abandoned.

Research and development of energy sources alternative to coal should be encouraged and expedited.

The production of steam in individual works and factories should be abandoned wherever possible in favour of joint services supplying steam and power from back-pressure central stations, i.e. dual-purpose generating stations located in industrial areas.

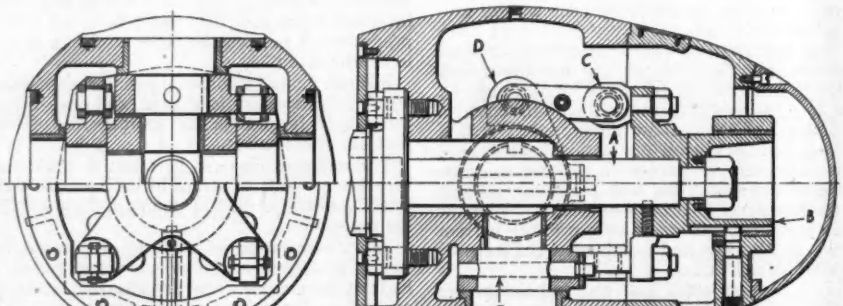
* Since this report was written a twenty-year loan scheme, interest free for two years, has been announced in Parliament.

† The Minister of Fuel and Power has announced the setting up of such an organisation through the British Productivity Council.

# Applications of the Controllable-Pitch Propeller

*( By Our American Correspondent )*

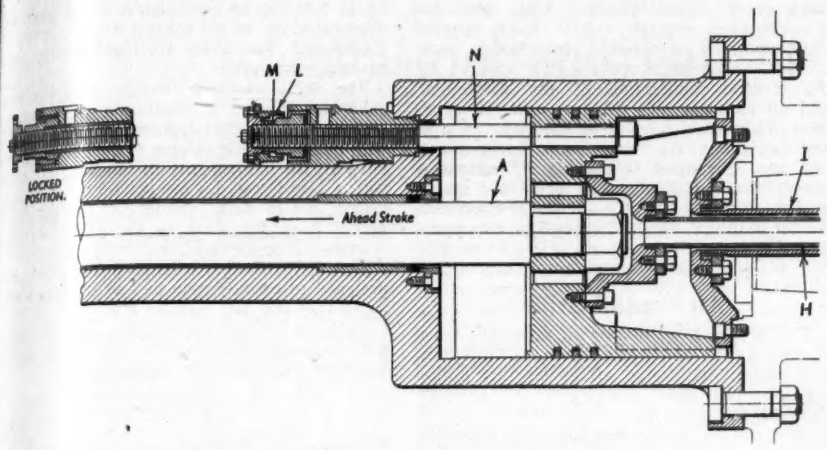
SINCE the last war, American shipbuilders and marine engineers have shown a growing interest in the use of controllable-pitch propellers, and the S. Morgan Smith Company, of York, Pennslyvania, is now manufacturing such propeller units for vessels of the U.S. Navy. This firm has been the American pioneer of the Kaplan adjustable-blade hydraulic turbine and thus has had considerable experience in the field of adjustable-pitch mechanisms. Shown in the accompanying illustration is the hub design for a 104in four-bladed, controllable-pitch propeller which has been installed on the tug " YTB–502 " of the U.S. Navy. This particular design has been based largely on that of the Kaplan turbine mechanism and it requires the removal of the propeller hub cone for the replacement of individual blades. The cross-sectional drawing reproduced above illustrates the servo-motor assembly for this installation.




**Hub Assembly of Controlled-Pitch Propeller**

The basic function of this controllable-pitch propeller is to provide complete control of the blade pitch for ahead or astern motion of the vessel, eliminating the reversing or stopping of the engines. The control of the blade pitch is accomplished by the axial movement of the piston-rod *A*, which is situated in the centre of the propeller drive shaft, and which, in turn, is connected to the crosshead unit *B*. The crosshead is connected to four heavy bushed links *C*, and to eyebolts which are pinned to the blade-trunnion lever arms *D*, and which, in turn, are pinned and keyed to the blade trunnions *E*. Any axial movement of the piston-rod, therefore, will develop a proportional movement in the pitch of the four propeller blades.

The control of the blade pitch originates in the pilot house or the engine-room by the manual movement of the pitch lever on the control stand. This pitch lever can be moved from full-ahead to the full-astern pitch setting. The actuation of this lever admits control air to either side of an air pilot servo-motor, which is situated on top of the oil control head. The movement of the air control piston develops proportional movement of an oil relay control valve. Movement of this oil relay control valve uncovers the proper ports in the valve body which admits or removes high-pressure control oil to or from either end of the main servo-motor cylinder, as illustrated opposite. The servo-motor piston is connected to the piston control rod, which actuates the propeller blades. The high-pressure control oil to and from the astern or after end of the main servo-motor piston moves through the inner oil pipe *H*. The control oil to the ahead or forward end of the servo-motor cylinder flows in and out through the annular space between the two control oil pipes *I* and *H*. The oil servo-motor forms a part of the main propeller shaft, and may be located wherever it is best suited in the overall




Servo-Motor Assembly of Controlled-Pitch Propeller

machinery design and layout. The unit described here was bolted directly to the hub of the brake drum installed in this tug.

The lock arrangement for the emergency locking of the propeller pitch in any position from full ahead to full astern is shown above. It is accomplished by setting the servo-motor piston to the desired pitch setting—by hand oil pump in emergency—and then screwing the lock nut *M* on the locking rod *N* to the locked position. The locking nut is then locked in position by the collar nut *L*. This tug installation has a propeller-pitch indicator situated in the pilot house and in the engine-room. There is a further arrangement in the pilot house and engine-room to indicate the fuel consumption of the diesel engines. This gives a direct indication of the horsepower output in conjunction with the engine revolution indicators. The installation described facilitates control of the propeller blade pitch from 24 deg. ahead to 21 deg. astern. The propeller hub is filled completely with lubricating oil which is supplied from an oil-equalising tank situated in the machinery space above the vessel's water line. The hub is, therefore, under a constant internal pressure which is slightly higher than the water pressure surrounding it. This method prevents water from entering the hub through the blade trunnion seals if seal damage occurs. High-pressure control oil is supplied to the oil head and servo-motor from an oil pressure accumulator set. The set consists of a pressure tank and an automatic electrically driven oil pump. The operating oil pressure range on this installation is 175 lb to 250 lb per square inch.

## The Production of "Fluon"

We learn that Imperial Chemical Industries, Ltd., is now operating a new plant making "Fluon" brand of polytetrafluoroethylene, which is now freely available after three years of restricted supply, resulting from an explosion which occurred in the original P.T.F.E. factory in 1950 and completely stopped production.

I.C.I. started producing P.T.F.E. on a limited commercial scale in 1948, and from the middle of 1949 almost the entire output was allocated for vital Government needs, the small plant being unable to satisfy developing industrial demands. Immediately after the explosion, I.C.I. started work on the new and larger plant at Blackpool.

Polytetrafluoroethylene, the only completely fluorinated high polymer, is remarkable for its wide range of working temperature, which extends from −100 deg. to +250 deg. Cent., or, in special circumstances, to 300 deg. Cent. In addition, it possesses extreme chemical inertness and solvent resistance, good mechanical and electrical properties and unique low-friction and non-stick characteristics.

The polymer is available as a granular white powder which can be fabricated by special techniques into a variety of forms—block and rod, extruded sleeving and cables, gaskets and packings, bearings and valve bases, film and many others. These are all available from trade fabricators in this country.

Because of its characteristic properties, "Fluon" has been successfully used in many applications, including gaskets, diaphragms and valve seats, oil seals, valve bases, parts of condensers and other electrical components for use at high frequencies and high ambient temperatures, insulation for motors and transformers, covered wire and cable, and insulating tapes and sheets.

It has also been used for dry bearings for loads up to 3 tons per square inch; barrier tapes for heat-sealing equipment; low-friction and non-stick linings for rollers, chutes, hoppers and guides; in equipment for handling glues and sizes, and for piston rings and other parts for very low-temperature work.

## London Oil Distribution Terminal

The commencement of operation of a bulk oil and petrol distribution terminal at Wandsworth represents the completion of the initial stage of the distribution plans in the south of England made by the Vacuum Oil Company, Ltd. The heaviest road tank wagons operate on the top of the underground storage tank which has a capacity of 650,000 gallons. This is the only underground tank in Great Britain which is constructed to allow for this form of operation.

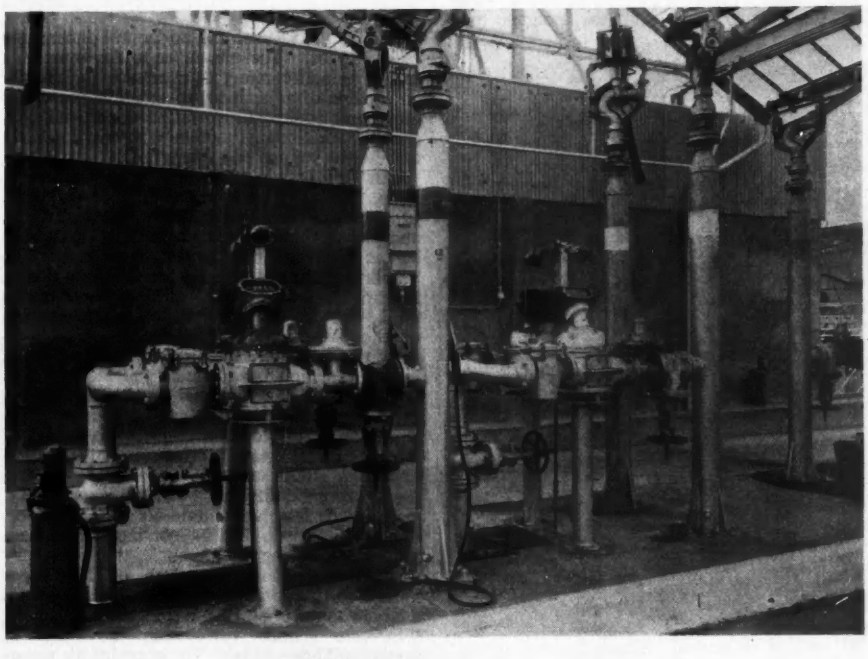
The underground tank measures 100ft by 110ft by 12ft and has a total capacity of 650,000 gallons. It has six compartments, four of 120,000 gallons and two of 85,000 gallons. The concrete surrounding the tank is 6ft thick at the sides and 3ft thick on the bottom. Immediately on the top of the tank is 1ft of concrete, 2ft of hardcore and 1ft of reinforced concrete slab.

The terminal handles three products: "Mobilgas Special," "Mobilgas" and "Mobil Diesel," which are carried up to Wandsworth by barge from Coryton. The barges each carry 75,000 gallons and are emptied by the discharge pumps on the wharf at the rate of 850 gallons per minute.

The loading area has been planned so that eight road tank wagons can be loaded simultaneously. The loading operation will soon include a facility whereby, through pneumatic hydraulic control of the pumping, a single operator on top of the vehicle can carry out the complete filling procedure. The control for this automatic device is located on the loading arm.

Road tank wagons are filled at the rate of 250 gallons per minute and a 2400 gallon capacity tanker can be loaded in fifteen minutes. The loading arms are of the spring-balance kind and each is fitted with a 3in Wayne "Flowmeter" which is accurate to 0·01 per cent or one gill in 150 gallons. All loading at the terminal and its delivery at the customers' premises is by "Flowmeter," which ensures accuracy. The metering equipment can be seen in our illustration.

This new installation has been constructed in the grounds of Vacuum Oil Company's oil blending and grease manufacturing works, which has been established at Wandsworth since 1919. It will supply an area of approximately 6000 square miles north and south of the Thames.



Metering Equipment at Oil Distribution Terminal

## Experimental Mobile Radio Equipment at London Airport

An experimental mobile v.h.f. radio scheme which, if generally adopted, could alleviate many difficulties in the ground operations of the world's airports, has been installed recently by the Ministry of Civil Aviation at London Airport. The General Electric Company, Ltd., supplied the equipment for the experiment at the request of the Ministry. Essentially, the equipment is a mobile extension of the airport telephone exchange and allows any subscriber on that exchange to keep in touch with a mobile

vehicle which may be up to 10 miles away from the airport centre, a range which is ample for all airport services.

Because the radio-equipped vehicle gives immediate, direct communication through the airport telephone exchange with any airport service, much time is saved. The system is also invaluable for airport maintenance and other ground functions.

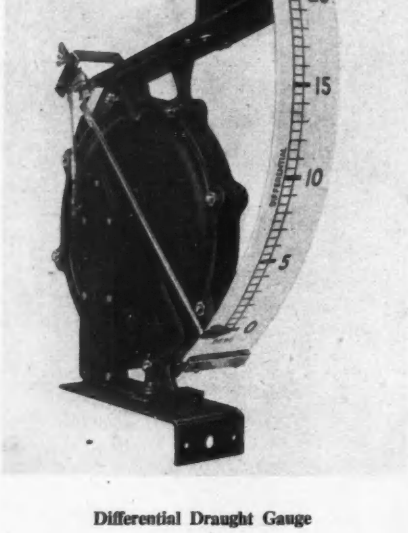
The amplitude-modulated "10/12" v.h.f. transmitter-receiver, which is installed in the rear of the vehicle, operates from the vehicle battery. It can operate on frequencies between 70 Mc/s and 180 Mc/s in certain specified bands, including the frequency allocated to vehicles towing aircraft. It is arranged for duplex operation; that is to say, the caller in the vehicle treats the equipment as if it were an ordinary telephone extension. It is not necessary to depress a switch before the speaker can be heard by the subscriber at the other end. A separate control unit conveniently sited close to the driver and passengers incorporates a loudspeaker, control switch and volume control.

In the airport building, an exchange matching unit connects an existing transmitter-receiver to the airport telephone exchange, thus allowing the extension of the exchange to a mobile subscriber. Associated with this unit is an indicator unit on the telephone exchange board. As an extension to the scheme, the fixed transmitter-receiver could be sited at any distance up to 5 miles from the telephone exchange itself, provided a line connection were available.

## Differential Draught Gauge

A RECENT development in the range of instruments manufactured by George Kent, Ltd., for assisting combustion control is the differential draught gauge which we illustrate below. The gauge is especially useful, the makers state, on those boilers fired with pulverised fuel, the load on the pulverising mill being indicated by the differential pressure across the mill, and there are similar applications for the gauge on sinter plants, &c.

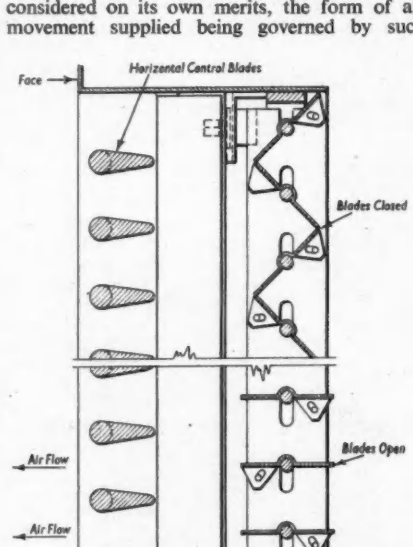
The measuring element is a diaphragm-operated mechanism. The diaphragm, which is of lambskin, divides two pressure-tight chambers, one receiving the upstream pressure and the other the downstream pressure, and is supported by two springs, one in either chamber. The spring in the upstream chamber ensures the correct direction of movement of the diaphragm, and the other spring, the "control spring," is of calibrated strength and governs the range of the instrument. The movement of the diaphragm is transmitted to the light balanced pointer by means of a linkage system through a pressure-tight gland. There is a zero-adjusting screw on the pointer arm, and the pointer indicates on a vertical edgewise scale calibrated in differential pressure units. When internal illumination is required a translucent scale is used. Consistent operation is ensured by the generous dimensions of the diaphragm, and an accuracy of ±2 per cent of maximum differential head is guaranteed. A dust and fumeproof case houses the differential unit and the instrument is capable of measuring up to 30in W.G. differential head, the ranges available being 0–2in, 0–3in, 0–4in, 0–6in, 0–9in, 0–12in, 0–16in, 0–20in, 0–25in, 0–30in. differential pressure.




Differential Draught Gauge

## Air Control Grille

THE provision of proper air movement in a ventilated or air-conditioned space is an important problem in the design of an air distribution system. The right amount of air, correctly supplied to the various spaces served by the system, will not ensure the success of an installation unless accompanied by suitable distribution within the spaces receiving treatment. Complications also arise, in that each space must be considered on its own merits, the form of air movement supplied being governed by such factors as the vertical and horizontal dimensions of the space. The air outlet grilles must, for environmental comfort or process requirements, be capable of adjustment to secure zones of air movement to suit all operating conditions, and should, additionally, embody means for controlling the volume of air supplied.




Cross Section of Grille

Our line drawing illustrates the "Deflecto" grille, produced by Richard Crittall and Co., Ltd., 151, Great Portland Street, London, W.1., and shows that each adjacent pair of damper blades is arranged for opposite movement. The primary advantage claimed for the grille is that high air velocities are permissible, without undue noise, due to the aerofoil design and spacing of the two sets of grille blades. The high-velocity air stream, can be discharged or diffused in any direction by adjusting the blades. The adjustment is made by hand or with the aid of a small key, and each blade can be adjusted independently to any desired angle; the setting of the horizontal blades gives vertical diffusion of the air stream and the vertical blades give the horizontal diffusion.

Intended for horizontal air discharge or, in certain cases, as in confined machinery spaces, for setting at an angle, the grille may operate at velocities in excess of 1000ft per minute for marine use. At these high velocities a large volume of air is delivered, resulting in one "Deflecto" grille performing the work of several ordinary grilles. The zones of air movement secured are of varying widths and lengths up to 80ft can be obtained, both of which are determined by the air velocity and the setting of the blades. The grilles are made in sizes from 6in square upwards.

The value of these flexible units has been enhanced by the incorporation of a volume control, and the total depth of the grille together with opposed blade damper is under 4in. Alternatively, the damper may be supplied separately with a 1½in frame, for use behind other types of grilles, and in ducts. Setting of the damper is visible from the front of the grille, and this operation is performed from the front by means of a loose key. The key actuates a cam mechanism designed to operate each pair of damper blades simultaneously and equally from the complete shut-off to full output positions. At full output the frictional resistance of the grille is not increased by the damper blades.

## Underwater Television Camera Lens

A PERISCOPIC lens, which has successfully undergone a number of tank tests, has been designed for use with the Marconi-Siebe, Gorman underwater television camera. It is controlled remotely from the ship above and can be made to "shoot" in any direction within a hemisphere, whether the camera is moving below the surface or not. The new lens overcomes many of the difficulties of televising underwater when weather conditions are poor and the apparatus is swinging with the tide, and allows the camera to scan a large area of the sea bed without having to move it either from above or by a diver.

The rigid lens could only "shoot" in the direction of the camera and in their search for an improvement the designers studied many optical systems before finding a solution. The new lens operates simply, and the tube containing it passes through a brass plate inside a watertight pressure casing which is fixed between the front of the camera and the viewing dome. The tube can rotate through a complete circle and its "eye," or front portion is pivoted to the tube, and can elevate through 90 deg. Thus the "eye" can look straight ahead, to the side or at any angle within this arc, and the lens is adjusted to look in the required direction within the hemisphere by control of the rotational and elevating movements. These are operated by servo-motors clamped to the brass plate and camera, and controlled from on board by a control unit which is connected to the camera through the watertight camera cable.

A "fish bowl" viewing dome of 1in thick Perspex replaces the former viewing window; it has the same refractive index as water, so that the image is not distorted and surface scratches do not show on the monitor screens. The lens forms part of a scheme to modernise the Marconi underwater television apparatus and the prototype pressure casing has been redesigned to reduce its weight. To fit the new casing, which has an internal diameter of 15in, a smaller camera is being manufactured, and it will have an overall length of 25in and be much more accessible for maintenance than the present design. The equipment is on view on the stand of Siebe, Gorman and Co., Ltd., at the Engineering, Marine and Welding Exhibition and the Chemical Plant Exhibition at Olympia.

OVERSEAS ECONOMIC SURVEYS.—The latest volumes in the series of overseas economic surveys prepared by the commercial relations and exports department of the Board of Trade deal with Denmark and with Belgium and Luxembourg. Each volume costs 3s. 6d. and is published by H.M. Stationery Office.

COURSES IN PHOTOELASTICITY.—Two lecture courses in photoelasticity are being arranged by the Faculty of Engineering, University College, Gower Street, London, W.C.1. The first course consists of twelve lecturers and demonstrations on the practical application of photoelastic methods to the investigation of two-dimensional stress distributions. The lectures will be given on Monday afternoons, from 2 to 3 p.m., beginning October 12th. The second course, which will also consist of twelve lectures, will deal with recent developments in the photoelastic investigation of three-dimensional stress problems. These lectures will be given on Monday afternoons, from 2 to 3 p.m., beginning February 1, 1954. The fee for each course is 7½ guineas, or 14 guineas if both courses are taken. The courses are available without extra fee to students of University College, who have paid composition fees.

# Industrial and Labour Notes

### The Trades Union Congress

The eighty-fifth annual Trades Union Congress is being held this week at Douglas, Isle of Man, under the presidency of Mr. T. O'Brien. The assembled delegates represent 183 affiliated unions with a combined membership at the end of last year of 8,088,450.

Mr. O'Brien delivered his presidential address last Monday morning. In the course of it he said that, throughout its history, the trades union movement had consistently maintained its determination to keep its independence. It had asserted its right to make its own decisions through its own machinery and had never subordinated itself to political parties or taken its instructions from governments. Mr. O'Brien then went on to deal with what he called some of the salient facts of the present economic situation. He said that the fall in the prices of raw materials over the past twelve months had been of such a character that the United Kingdom's balance of payments problem had been greatly eased, and, at the same time, this country's export prices had remained relatively steady. It would be foolish, however, to think that a favourable trend of that character must necessarily continue. It was necessary, Mr. O'Brien went on, to emphasise again and again that this country and its industries carried the major responsibility for the provision of capital and equipment over the whole sterling area, and a tremendous effort must be made to expand productivity and regain and increase our overseas trade. It was the aim of trade unions, Mr. O'Brien added, to raise the living standards of their members, and increased productivity was the means to that end. The idea of deliberately refusing to increase productivity was simply nonsensical, and, Mr. O'Brien commented, it was almost weak-minded to suggest that increased productivity simply meant more profit for the bosses and no profit for anyone else.

In another part of his address, Mr. O'Brien said that trade unions could have no choice but to take the necessary steps to safeguard their members' interests, though in that field the unions were confronted with a dilemma. If they took steps to increase wages it was a virtual certainty that the increased cost would be passed along to the consumer by way of price increases, and most of the consumers were wage earners. Trade unions to-day, therefore, accepted the principle that protection of their members did not lie wholly in securing an increase of money wages. Their task necessitated a close and careful scrutiny of economic policy and trends in order to safeguard their members' employment. A reasonable rate for the job was only part of the test. It was equally important, Mr. O'Brien said, that there should not only be a good rate for the job, flexibly adjusted to price movements, but that there should be a job available to which the rate applied.

### Employment and Unemployment

The Minister of Labour has reported that during July the total working population of Great Britain increased by 27,000 (2000 men and 25,000 women), and at the end of the month numbered 23,352,000 (15,864,000 men and 7,488,000 women). Of that total, 22,214,000 were in civil employment.

In the basic industries of the country, 4,077,000 were employed at the end of July, a net increase of 10,000 compared with a month earlier. The increase was mainly a seasonal one brought about by the larger number of people engaged in agriculture and fishing. In the mining industry, the labour force declined by 2000 during July, the number of wage earners on colliery books at the end of the month being 718,000. In the manufacturing industries there was a net increase during the month of 9000 in the number of people employed, making the total 8,732,000. The biggest addition in July was in the food, drink and tobacco trades. In the "engineering, metal goods and precision instruments" manufacturing group there was a decrease of 5000, bringing the number employed to 2,520,000, compared with 2,558,000 at the end of last year. In other occupations outside the basic and manufacturing industries the principal employment changes in July were in building and contracting, where the number of people engaged fell by 8000 to 1,440,000, and in "professional, financial and miscellaneous services" in which 3,997,000 people were employed, or 6000 more than at the end of June.

Unemployment figures which were issued by the Ministry of Labour this week show the position at August 10th, when there were 293,536 people registered as out of work, compared with 272,676 on July 13th. The Ministry estimates that the August figure represented 1·4 per cent of the total number of people employed.

### Education and Training for Management

The British Institute of Management has recently published the first of two volumes surveying the facilities in the United Kingdom for education and training in management. The purpose of this survey is to bring together details of the subjects coming within the field of management which are taught at British universities and technical and commercial colleges and which are included in the examinations of professional and educational bodies.

The present volume deals with the undergraduate and post-graduate courses at a number of universities, university colleges and associated colleges of technology. In effect, the survey is a fairly detailed catalogue of the courses available, which includes, in most cases, the full syllabuses for engineering and commerce degrees and for degree and diploma courses in economics and other subjects. It will undoubtedly be a useful guide to all who are in any way concerned with management, education and training.

The volume is obtainable from the British Institute of Management, 8, Hill Street, London, W.1, at 7s. 6d.

### Output and Employment

According to *Bulletin for Industry*, which is the monthly review of the economic situation prepared by the Treasury, industrial production in the first six months of this year was 4 per cent higher than a year ago and from 1 to 2 per cent higher than in the first half of 1951. This recovery, it is stated, has occurred largely as a result of the revival in home demand for goods, though in the second quarter of this year there was also some recovery in the volume of exports. Most of the rise in production has been obtained by using existing resources more fully than in 1952—there has, for example, been less short-time working—but from mid-1952 to mid-1953 there was also an increase of 1 per cent in the number of people employed in industry.

The *Bulletin* goes on to deal with the principal changes in industrial output. It says that the increases in production have been chiefly in textiles, clothing, leather goods, food, building and contracting, and in vehicles. For the most part these increases have resulted from a bigger home demand, although exports of many kinds of textiles and of motor-cars and aircraft were higher by volume in the second quarter of this year than they were a year earlier. But the main decreases in production have been in the engineering and other metal industries with some notable exceptions such as vehicles, cranes and excavators, and civil engineering plant. As with production, the main increases in employment between mid-1952 and mid-1953 were in textiles, clothing, and in the food group of industries, although in all these industries the total number of people engaged in June this year was still about 65,000 less than in mid-1951. On the other hand, the main decreases in employment between mid-1952 and mid-1953 were in the metal manufacturing and metal-using industries. In this group the number employed in the aircraft industry rose by 22,000, and there were also small increases in the numbers employed in blast furnaces and iron and steel melting, in shipbuilding, and in locomotive and rolling stock building. Nevertheless, the *Bulletin* shows that there was a net decrease of 18,000 in the number employed in metal manufacture, of 28,000 in the engineering, shipbuilding and electrical goods group, and of 20,000 in other metal goods industries. In spite of the decline during the last twelve months, however, the number of people working in the metal industries in June this year was still about 75,000 greater than at mid-1951. In the aircraft industry, in particular, employment has risen steadily and in June last was 35 per cent higher than at mid-1951.

The *Bulletin* concludes its survey by saying that, in the past year, industries which have been able to increase the volume of their exports or which have been engaged on defence work have generally been able to secure the manpower they needed, apart from some classes of skilled workers. Although skilled workers are still needed in some metal industries, there does not appear to be any general shortage of manpower. In these circumstances, the *Bulletin* adds, it should not be difficult to produce more goods for export when the markets for them are found.

### The Coal Situation

This week the seventh summer school to be arranged by the National Coal Board is taking place at Oxford University. It is attended by 500 or so of the Board's employees. The school was opened last Saturday, the introductory address being delivered by the chairman of the Board, Sir Hubert Houldsworth. In the course of his remarks, Sir Hubert said that the miners' second week's holiday and the Coronation holiday had resulted in a loss of 4,900,000 tons of coal, although over 3,000,000 tons of that had now been made up. In spite of the holiday loss, Sir Hubert continued, there had been on the average an increased coal production of 130,000 tons a week since the end of March, when the new efficiency campaign in the mines was completed. That, he commented, was not a bad start, but the result was one which could not be viewed with complacency. New ideas and new techniques must be used to improve the efficiency of the coal industry, Sir Hubert urged, for he did not think that the industry would ever attain, by present-day techniques, the degree of efficiency which the nation demanded.

On Monday one of the subjects studied by the school was the cost of coal production. Mr. E. F. Schumacher, the Coal Board's economic adviser, said that last year just over half this country's output of deep-mined coal was produced at an operating profit and just under half at an operating loss. About 35,000,000 tons of coal from 283 pits was produced at losses of 10s. a ton or more, and Mr. Schumacher emphasised that the primary job of those 283 pits was to reduce their costs to a reasonable level, even though that might mean some loss of output. On the other hand, he continued, there were 340 pits producing 51 per cent of the country's deep-mined coal output at profits ranging from a penny to over £1 a ton, and those were the pits to which the Board was looking for additional production. There were some, of course, which were working to capacity and therefore could not expand, but there were others which could expand, and indeed would expand, at a price. The price, Mr. Schumacher explained, was higher average costs. He went on to say that, as a first approach, the profitable half of the coal mining industry should put primary emphasis on output expansion, even at the cost of occasionally ceasing to be profitable, while the 283 pits which were running at average losses of 10s. a ton or more should put primary emphasis on cost reduction, even at the cost of possibly having to reduce their output.

# Notes and Memoranda

## Rail and Road

MEETING OF TRANSPORT MINISTERS.—The Belgian Minister of Communications, Monsieur P. W. Segers, has invited the transport ministers of the member countries of the Organisation for European Economic Co-operation, together with those of Spain and Jugoslavia, to take part in a conference to meet in Brussels in October. The purpose of this conference, which was the subject of a recent recommendation by the council of O.E.E.C., is to set up, on a permanent basis, the "European Conference of Transport Ministers." The Governments of the United States and Canada have been invited to send observers. The Ministers will have before them when they meet in Brussels the report of the Conference on European Inland Transport, which took place recently under the chairmanship of M. Attilio Cattani, chairman of the O.E.E.C. Executive Committee.

INDUSTRIAL DIESEL LOCOMOTIVE.—To the range of small diesel locomotives built by the Hunslet Engine Company, Ltd., there has now been added a 35 h.p., four-wheeled unit of 5 tons weight and 2·6 tons maximum axle load, for use on narrow gauges from 1ft 11½in upwards. It is powered by a Perkins "P4" oil engine set to a top output of 35 b.h.p. at 1700 r.p.m. The drive is taken through a Hunslet two-step gearbox giving track speeds of 3·85 and 7·7 m.p.h. The maximum tractive effort in bottom gear is 2900 lb and in top gear 1450 lb, the former giving an adhesion factor of 3·86 to 1. The 18in wheels are spread over a base of 3ft and the locomotive has a length over buffer beams of 8ft 11in. Loads up to 160 tons can be started and hauled in bottom gear and curves of 25ft radius can be traversed by the locomotives, which are sold through Robert Hudson, Ltd., of Leeds.

## Air and Water

MARINE SUPERINTENDENT.—The Orient Line announces that Captain Paul Sargent, D.S.C., R.D., R.N.R., who has been assistant marine superintendent since 1945, has been appointed marine superintendent in succession to Captain G. S. Kennedy, C.B.E., who has held the position since 1936 and has completed forty-one years' service with the company.

COMMONWEALTH ADVISORY AERONAUTICAL RESEARCH COUNCIL.—The third meeting of the Commonwealth Advisory Aeronautical Research Council was opened on Monday last in London by Sir John Cockcroft, chairman of the Defence Research Policy Committee. This year's chairman for the meeting is Professor A. G. Pugsley, F.R.S., Chairman of the Aeronautical Research Council. A statement on the work of the third meeting will be issued after the final session of the council on September 19th.

DEMINERALISATION OF SALT WATERS.—The Organisation for European Economic Co-operation last year set up a working party to study methods of demineralising salt waters. The working party's terms of reference include also the co-ordination of research into the subject. One of the initial steps taken by the working party has been the appointment of a group of experts to collect information about various known processes of demineralisation. As a result data has now been assembled for the working party's consideration on high pressure distillation, vapour compression distillation, distillation with solar energy, separation by freezing out, ion-exchange, and electrodialysis. The countries represented in the working party are the United Kingdom, Belgium, France, Denmark, Germany, the Netherlands, and Sweden. Its sessions have also been attended by observers from Australia, South Africa, the U.S.A. and the Rockefeller Foundation.

WATER SUPPLY IN NORTHERN RHODESIA.—We have received a copy of the annual report for the year 1952 of the Water Development and Irrigation Department of Northern Rhodesia. It is pointed out that the department is following a policy in the construction of earth-fill, puddle-core dams whereby it concentrates on the larger engineering structures, leaving the small dams to be built by other departments and by native authorities. The department's capacity for such work has increased and 1952 was the first year of large dam construction. In a number of dams the spillways presented interesting problems and more work was involved in designing and constructing the spillways than in building the dams. The standard of work in 1952 improved and the volume of earth-fill placed showed an increase over previous years; valuable hydrological data in relation to run-off was obtained and advances were made in the study of the behaviour and regime of the territory's rivers. Generally, the year's work was considered very satisfactory.

CARGO HANDLING ASSOCIATION.—The International Cargo Handling Co-ordination Association states that there has been a wide expansion of membership in the European countries, South Africa, India, Pakistan, Malaya, Burma and the United States, and growing interest among those who handle, transport and pack cargo. Following upon the Timber Symposium there is to be held on October 1st, on board the "Wellington," the headquarters ship of the Honourable Company of Master Mariners, a Unit Load and Palletisation Symposium, at which four papers will be read, entitled: "Unit Loads and Palletisation," "Road Transport Afloat," "An Industrialist's Appreciation of Pallets," and "Ship Types as Influenced by Container and Unit Load Cargoes." Among the many problems studied by the Association is that of opening up new territories and to solve this a Portable Harbour Scheme has been developed and it is anticipated that a ship will be built and specially equipped to carry components of the harbour. Experiments in the handling of bulk sugar cargoes has resulted in the development of a special conveyor which is expected to be available for use shortly. The Association also states that the general technical meeting will take place in the Palais des Congres, in Naples, under the auspices of the Italian National Committee, presided over by Dr. Luigi Accame, to coincide with the International Maritime Exhibition.

## Miscellanea

MR. R. C. WALKER.—We have learned with regret of the death, on August 7th, of Mr. R. C. Walker, A.M.I.Mech.E., A.M.I.E.E., of The General Electric Company, Ltd. Mr. Walker had charge of technical and commercial development of photocells, Geiger Muller counter tubes and special electronic devices in the company's Osram valve and electronics department.

WELDING DESIGN COURSES.—A lecture course on "The Design of Welded Structures" is being arranged by the Quasi-Arc Company, Ltd., Bilston, Staffordshire. The lectures will be delivered on Tuesday and Wednesday evenings at 6 p.m., beginning October 27th, at the Cleveland Technical Institute, Middlesbrough. The company will be glad to provide full details of the course, which will extend over a period of seven weeks.

STEELMAKING COURSE FOR UNDERGRADUATES.—Last week a number of boys from public schools in this country participated in a short course in iron and steelmaking arranged by The United Steel Companies, Ltd. This week, thirty-four undergraduates from thirteen universities are in Sheffield as the guests of The United Steel Companies, Ltd., to study some of the aspects of steelmaking, steelworks engineering and research.

VAUXHALL WORKS EXTENSION.—Work has started on a 144,000 square foot extension to the branch factory at Dunstable of Vauxhall Motors, Ltd. This extension will cost over £750,000, and the extra space will be used chiefly for the manufacture of spare parts for non-current Vauxhall and Bedford vehicles. This work is at present divided between the Dunstable factory and the main plant at Luton, and with the extension it will be concentrated at Dunstable, so that the manufacture of spare parts at Luton can be confined to those for current models.

FARM MANAGEMENT AND MECHANISATION.—The British Institute of Management and the Association of Agriculture are arranging a conference to discuss "Farm Management and Mechanisation." It will be held at Management House, 8, Hill Street, London, W.1, on Wednesday, September 30th. A conference luncheon, on the same day, will take place at the Park Lane Hotel, Piccadilly, W.1. Full particulars may be obtained from the British Institute of Management, 8, Hill Street, W.1, or from the Association of Agriculture, Abbey House, Victoria Street, S.W.1.

PERSONNEL RECORDS.—The Industrial Welfare Society has produced a new and revised edition of its publication entitled *Personnel Records*. The book is intended to serve as a guide to all who are concerned with the formulation and maintenance of systems for recording information about staff and workpeople. It does not suggest that any one record or system is the ideal, but in its text and illustrations it presents some useful details representative of current practice. The book has been edited by Mr. Gordon Bevan. Its price is 7s. 6d. and it may be obtained from the Industrial Welfare Society, 48, Bryanston Square, London, W.1.

IMPORT DUTIES ON IRON AND STEEL.—The import duties on certain iron and steel goods were suspended for one year from September 19, 1952, by the Import Duties (Exemptions) (No. 4) Order, 1952. The Board of Trade has now announced that the Import Duties (Exemptions) (No. 3) Order, 1953, which comes into force on September 19th, continues the suspension of these duties, with some modifications, for a further period of six months. One new heading in respect of sheets and strip coated with an inorganic silicate to a thickness not exceeding 0·1mm has been added to the schedule to the Order; this covers certain kinds of electrical sheets and strip. Heat-resisting alloys of a kind used for electric heating elements, cold rolled plates, sheets and strip of a width not exceeding 18in, and barbed and single wire are excepted from the new Order.

THE LATE MR. W. O. FENWICK.—It was with great regret that we learned of the death on August 29th of Mr. W. O. Fenwick, technical editor of the *Electrical Review*. William Oliver Fenwick was born in Cairo in 1893. He received his technical education at Faraday House, where he gained the diploma. After a brief period in the drawing office of Fielding and Platt, Ltd., he joined the Bristol Electricity Department in 1914 as assistant mains engineer, and later became assistant power station engineer. In 1917 he was appointed assistant plant superintendent at the Ailsa Craig Shell Factory. He joined the *Electrical Review* in 1918 as assistant to the technical editor, the late A. H. Allen. In 1948 he succeeded Mr. C. O. Brettelle as technical editor. He became an associate member of the I.E.E. in 1918 and a member in 1942. He was a member of the B.S.I. Committees on electrical symbols and abbreviations.

COURSE ON GEOCHEMICAL PROSPECTING.—More than fifty British, Colonial and overseas mining experts will attend a course in geochemical prospecting at the Royal School of Mines, London, between September 14th and September 25th. Geochemical prospecting is a method of locating valuable minerals by chemical analysis of samples of earth from the district being prospected. The course will give the experts guidance on the use of geochemical prospecting methods and will include lectures and discussions on the technique. During the course, Dr. J. S. Webb, of the mining geology department of the Royal School of Mines, will lecture on "Principles and Field Practice." Demonstrations of analytical procedure will be given by Mr. H. W. Lakin, of the United States Geological Survey, and chromatographic and spectrographic methods of analysis will be demonstrated by Mr. R. A. Wells, of the Chemical Research Laboratory, and Dr. J. R. Butler, of the Rothamsted Experimental Station.

LIGNITE IN THE INDIAN STEEL INDUSTRY.—Investigations concerning the use of lignite in the direct reduction process in the iron and steel industry have recently been made at the instigation of the Government of Madras. According to *Indian Trade and Industry*, high-grade coking coal is largely used at present for the production of iron and steel from iron ores. Indian resources of good coking coal are limited and this quality coal occurs mostly in Bihar. Iron ore occurs in a number of places in India where coking coal is not available, and it is stated that unless an alternative to coking coal is made available, the economic production of iron and steel is not practicable in these regions. The recent investigation therefore is of great interest especially in the case of Madras state where lignite and iron ore occur in close proximity to each other. The reactivity of the different forms of lignite examined for their efficiency as reducing agents was found to depend on the treatment they had undergone prior to their use. Some dried lignite is more reactive than natural lignite, while other dried lignite is as reactive as steamed lignite.

## Contracts

HENRY ROBB, Ltd., Leith, has received an order from the Railway Executive for a single-screw, twin-grab hopper dredger for work in Lowestoft Harbour. The ship will be propelled by diesel machinery and the two dredging cranes and grabs will be supplied by Priestman Brothers, Ltd.

THE FRASER AND CHALMERS ENGINEERING WORKS OF THE GENERAL ELECTRIC COMPANY, Ltd., are to supply to the order of Guest Keen Baldwins Iron and Steel Company, Ltd., one 5000kW turbo-alternator set, complete with condensing plant. This set is for an extension to the existing power station at the East Moors Works, Cardiff.

THE BONNEVILLE POWER ADMINISTRATION has placed with English Electric Export and Trading Company, Ltd., a contract for a 250MVA, three-phase transformer bank for service on the 230,000V transmission system in the State of Oregon. It will comprise three single-phase units, each unit, complete with oil, weighing 150 tons. The transformer bank will be built at the Stafford works of the English Electric Company, Ltd.

## Personal and Business

BROOK MOTORS, Ltd., Huddersfield, announces the appointment of Mr. A. D. Bailey as manager of its Newcastle branch.

THE IRON AND STEEL BOARD, Norfolk House, St. James's Square, London, S.W.1, states that its telephone number is now Trafalgar 8833.

UNITED DOMINIONS TRUST, Ltd., states that its Liverpool office is to be moved, on September 21st, to Sefton House, Exchange Buildings, Liverpool, 2.

THE GENERAL ELECTRIC COMPANY, Ltd., announces the retirement of Mr. S. W. Richards, manager of its mines department. He joined the company in 1931.

CROMPTON PARKINSON, Ltd., states that the traction, commercial and car starter batteries formerly marketed under the trade name "Young" now take the name "Crompton."

WITTY AND WYATT, Ltd., 38, Commercial Street, London, E.1, has been appointed sole distributing agent for the "Lorvis" spanner in all areas of England and Wales south of the Humber–Mersey line.

THE GENERAL ELECTRIC COMPANY, Ltd., announces the retirement, on September 30th, of Mr. P. H. Nye, manager of the business development department. Mr. Nye has completed fifty-four years in the company's service.

F. J. EDWARDS, Ltd., 359–361, Euston Road, London, N.W.1, has been appointed sole distributor in the United Kingdom of the woodworking machinery manufactured by Tanner Engineering, Ltd., Auckland, New Zealand.

MR. THOMAS A. HOLME, who has been closely associated with the development and production of fabricated structures in the electrical industry for the last twenty-five years, has retired from the British Thomson-Houston Company.

THE ENGLISH ELECTRIC COMPANY, Ltd., states that its Bristol office has been moved to 74–76, Broadmead, Bristol, 1 (telephone, Bristol 27304). The television and domestic appliance service department remains at 155, Whiteladies Road, Bristol, 8 (telephone, Bristol 38253).

BUCKTON, Ltd., 63, Stockport Road, Ashton-under-Lyne, states that it has formed a new company, to be known as Eric Hewitt and Co., Ltd., to handle the sales of its contractors' plant. The company will operate, for the present, from 63, Stockport Road, Ashton-under-Lyne.

PEST CONTROL, Ltd., Cambridge, announces the formation of a subsidiary entitled British Straddle Carrier Company, Ltd., to deal with sales of the "Timber Wolf" and "Steelmaster" straddle carriers. The new company's registered offices are at 7, Chesterfield Gardens, London, W.1 (telephone, Mayfair 6840).

# British Patent Specifications

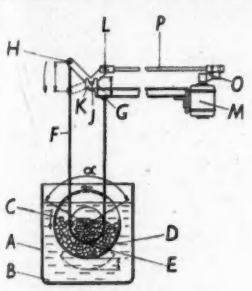
*When an invention is communicated from abroad the name and address of the communicator are printed in italics. When an abridgment is not illustrated the specification is without drawings. The date first given is the date of application; the second date, at the end of the abridgment, is the date of publication of the complete specification.*

*Copies of specifications may be obtained at the Patent Office Sales Branch, 15, Southampton Buildings, Chancery Lane, W.C.2, 2s. 6d. each.*

## METALLURGY

**694,971.** October 5, 1950.—TREATING METAL PARTS, Georg Fischer Aktiengesellschaft, Schaffhausen, Switzerland.

The invention relates to an arrangement for the pickling of metal parts contained in a barrel which, in order to cause a liquid substance to act on the goods to be treated, is rotated about its horizontal axis while being moved up and down in a tank containing the liquid substance. The drawing shows a tank or vat *A* filled with a liquid *B*. A cylindrical drum or barrel *C* accommodates the metal parts *D* to be treated. The barrel is provided at its ends with grooves *E* serving as guides for two steel ropes *F* whose ends *G* and *H* are secured to a two-armed lever with arms of unequal length pivoting on a shaft *J*. The shaft of the lever is supported in bearing brackets *K*. A further arm *L* secured to the two-armed lever is

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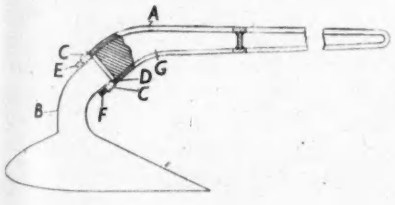
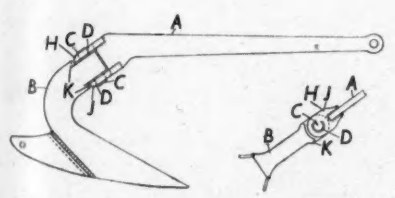
acted upon by the connecting-rod *P*. The motor *M*, through the agency of a crank *O*, gives the connecting-rod *P* a reciprocating motion, with the result that it pivots the two-armed lever through an angle of approximately 90 deg., which results in a rotary motion of the barrel about its own axis. During the reciprocatory motion the end *G* of the steel rope performs a shorter stroke and the axis of the barrel is raised by half the difference between the strokes and lowered again.—*July* 29, 1953.

## MARINE ENGINEERING

**694,976.** July 28, 1951.—IMPROVEMENTS IN ANCHORS, Simpson-Lawrence, Ltd., and Stanley McAllister, both of the company's address, St. Kentigern Works, St. Andrew's Square, Glasgow; and The Security Patent Anchor Company, Ltd., Blossoms Inn, 23, Lawrence Lane, London, E.C.2; and Kenneth Llewelyn Wright, Whifflet, Coatbridge, Lanarkshire.

In an anchor according to the invention, the fluke arm presents two pintles engaging sockets in the anchor shank, the pintles being solid with the fluke arm. In the drawings *A* is a shank and *B* a fluke arm presenting pintles *C* engaging sockets *D* in the shank. In the construction shown in the upper view the

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pintles *C* are integral with the fluke arm *B* and the shank *A* is of I section, presenting upper and lower flanges *E* and *F* extending beyond the web *G* and formed with the sockets *D*. The flange *E* and the flange *F* are welded to the web *G* after the pintles have been engaged with the sockets. In the construction shown in the lower view flange pieces *H* and *J* are welded to the end of the shank for reception of the pivotal end of the fluke arm *B*, the fluke arm having shoulders *K* engagable with lateral extensions formed by the flange pieces *H* and *J* to limit the amount of swing of the fluke arm.—*July* 29, 1953.

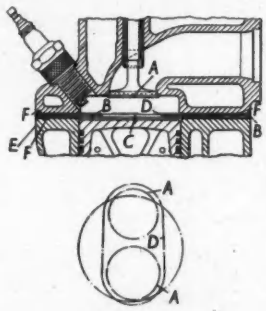
## INTERNAL COMBUSTION ENGINES

**695,574.** October 13, 1950.—THE MANUFACTURE OF EXHAUST VALVES, Alfred Teves Maschinen-und Armaturenfabrik Kommandit-Gesellshaft, Gustavsburgstrasse 31, Frankfurt, Germany.

This process for the manufacture of internal combustion engine exhaust valves provided with a reinforcement to protect them against the effects of temperature and corrosion, is characterised in that the reinforcement is applied by means of welding to the valve preformed substantially into its final shape. The valve is then heated to forging temperature and forged in a die so as to mould the surface of the valve and the reinforcement, the surface being subsequently finished by machining. According to the invention, instead of a non-forgeable and very difficultly worked reinforcing material a forgeable reinforcing material is used, for example, a nickel-chrome alloy containing 60 per cent to 80 per cent nickel and 15 per cent to 20 per cent chromium. By reason of the moulding of the seat—including the reinforcing layer—which is made possible in this way, the necessary machining is reduced to a minimum and not only is the expenditure of work considerably reduced but a considerable saving in reinforcing material is effected. The forging provides in addition a compression and strengthening of the reinforcement layer, which contributes to an increase in the life of the valve. The process makes it possible to manufacture a valve which is not only reinforced on the seat, but also at the outer peripheral surface, at the region of the greatest diameter of the valve, and the valve is therefore provided with an effective protection at the places subjected to the greatest temperature and corrosion effects. The process may be improved by preheating the applied reinforcing material, before the forging operation, not merely to the forging temperature but to a temperature which lies immediately below the melting point of the reinforcing material. When a material preheated in this way is forged it is rendered fluid under the pressure of the forging operation, and the porous spots which result from the welding on of reinforcing material in wire or ring form are removed —*August* 12, 1953.

**695,580.** December 16, 1950.—COMBUSTION CHAMBER DESIGN, The Austin Motor Company, Ltd., Longbridge Works, Northfield, Birmingham; and William Layland, of the company's address.

This invention has for its object to provide improved means, in an internal combustion engine, for obtaining turbulence or "squish" and also means for preventing excessive heat due to compression caused by the advancing flame. Referring to the drawings, the

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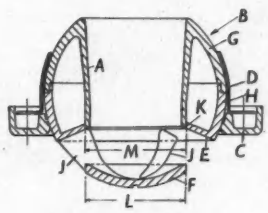
piston is shown at top dead centre of its stroke, and in the cylinder head are seen the combustion chamber, a spark plug, and one of the usual two inlet and exhaust poppet valves *A*. A metal plate *B*, preferably of copper, is located between the piston and the sparking plug and valves *A*, the plate extending transversely into the opening *C* through which the charge must pass from the cylinder into the combustion chamber during the compression stroke, so that the opening is restricted by the plate *B*. The plate is formed with a through opening *D* of elongated form, as shown in the lower view, which is of such shape and size that when its edge is projected axially with respect to the cylinder into the combustion chamber it defines thereon an area which includes the heads of both valves. The plate is located and held in place by positioning it with those portions which do not project transversely to restrict the opening, located between the cylinder block *E* and the head, packing gaskets *F* being shown at both sides of the plate. With this arrangement a single plate, with openings *D* appropriately placed for each cylinder, is provided for one engine. In the specification a modified design for a hemispherical cylinder head is also shown. The effect of the plate *B* is to produce "squish" and minimise any tendency to "pinking," whilst at the same time offering a minimum of restriction to the free flow of gases through the valves. Further, where the separate plate is of metal of high thermal conductivity, such as copper, tendency to "pinking" is further reduced, since the plate acts in the manner of a cooling fin to conduct away excessive heat.—*August* 12, 1953.

## AIR DISTRIBUTION

**695,066.** May 17, 1951.—AIR DISTRIBUTOR DEVICE, Iain Maxwell Stewart, 150, Helen Street, Glasgow, S.W.1.

Referring to the drawing, the air distributor shown includes a nozzle *A* in a ball member *B* universally adjustable in a socket *C* and *D* applied to an air duct or air box. Around one of the nozzle openings in the ball member the surface is flat or concave as at *E*, and spaced from this surface is a diffusing plate *F* of which the outer surface lies within, or forms part of, the spherical boundary of the ball member *B*. The ball




No. 695,066

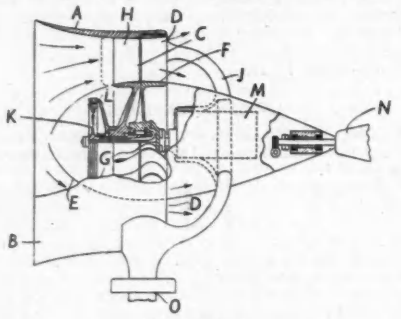
member being rotatable, the air flow issuing from the device may be in the form of a concentrated jet or of a diffused stream and its direction may be controlled at will. The ball member is made of plastic material and is so devised that it can be made from two moulded parts only. One part *G* of the ball member is in the form of a spherical segment with the nozzle *A*. The other part *H* comprises the residual portion of the ball wall, the apertured wall *E* surrounding one end of the nozzle, the diffusing plate *F* and the supporting arms *J* of the plate. The central aperture *K* of the wall *E* is entered by the adjacent end of the nozzle when the two parts are brought together. The half balls present shouldered portions designed to mate with one another. It will be seen that a moulding of the part *H* containing the diffusing plate *F* cannot be removed from the ordinary construction of die unless the diameter *L* of the plate *F* is less than that *M* of the aperture *K* in the wall *E*. The diameter *M* of the aperture *K* is equal to the nozzle bore plus twice the thickness of the nozzle wall at this point. Now, the degree of diffusion of an air stream depends on the diameter of the diffusing plate *F*, its shape, and its distance from the nozzle, and for effective diffusion it is desirable to have the plate greater in diameter than the nozzle outlet. In the present construction the nozzle outlet diameter can be exceeded by an amount slightly less than twice the wall thickness referred to, which is found in practice to be sufficient to give the desired results, perferably with a plate *F* having a concave inner surface spaced as far from the nozzle outlet as practicable.—*August* 5, 1953.

## WIND MOTORS

**695,519.** August 15, 1951.—WIND TURBINES, Antonio Felix Ribeiro, Rua da Ilha Terceira No. 38–30, Lisbon, Portugal.

The invention relates to a wind turbine driven by displacement of air arising from wind currents, and is claimed to provide a machine of relatively simple construction capable of high efficiency and speed. In the drawing there is shown an annular outer casing *A* having a flared inner surface of convergent-divergent configuration decreasing in diameter from an air intake mouth *B* at one end to a zone of minimum diameter *C* and increasing in diameter from that zone to an annular discharge port *D* at the opposite end, the discharge port being of larger diameter. Within the casing *A* is mounted concentrically a substantially egg-shaped central member *E* having a turbine wheel *F* on an axial spindle *G*, the rotor of the turbine wheel having a surface coincident with the development of the form of the central member *E*, which is so mounted that its maximum diameter is coplanar with the minimum inside diameter *C* of the outer casing. Between the central member *E* and the outer casing at the coplanar portion is mounted an annular pattern of stationary distributing blades *H* joining the outer casing *A* and the central member *E*. The arm *J* assists in effecting a rigid connection between the casing, distributing blades and central member. A centrifugal governor

*K* controls the speed of the turbine by means of a brake shoe acting on a drum *L*, and is actuated by the spindle *G*. The speed of the turbine may either be controlled by the braking means or by a shutter blanking off a portion of the air intake mouth. The turbine can drive an electric generator, pump *M*, or any other mechanism, as desired. The rear of the central member *E* is provided with a dovetail rudder *N*; the entire assembly is adapted to pivot at *O*.

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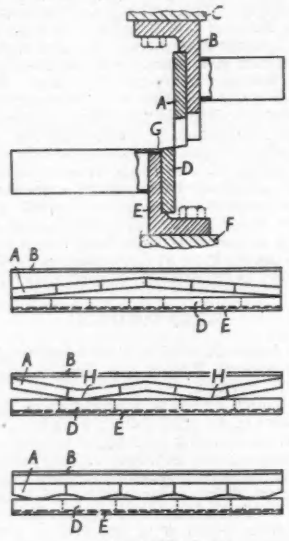
When in use, air enters the air intake mouth *B* and is caused to increase its velocity while progressing along the progressively decreasing annular intake until upon reaching the stationary distributing blades *H* the air is deflected on to the turbine wheel *F*, causing it to rotate. The spent air is then ejected at the discharge port *D*. It will be apparent that the increased velocity imparted to the air flow will increase the power output normally produced.—*August* 12, 1953.

## MACHINE TOOLS

**695,331.** June 27, 1951.—PLATE SHEARS FOR SHEET METAL, Kurt Prange, Maistrasse, 25, Munich, Germany. (*Inventor : Emil Becker.*)

The invention relates to machine plate shears of the kind in which the cutting edge of the upper movable shear-blade is so constructed that the metal sheet to be cut, lying on the single fixed straight-lined lower shear-blade, will be cut at least at two points at the same time. As shown in the upper view, the upper blade *A* is fixed to the blade holder *B* secured to the movable blade support *C*. The rigid lower blade *D* is fixed to the blade holder *E* fixed to the under-frame *F* of the machine. The lower blade is horizontal, as usual, and is fixed against the front edge *G* of the table of the machine. The edge of the upper blade *A*, as the second view shows, is so shaped that the two cutting edges are inclined to the horizontal run from the higher centre



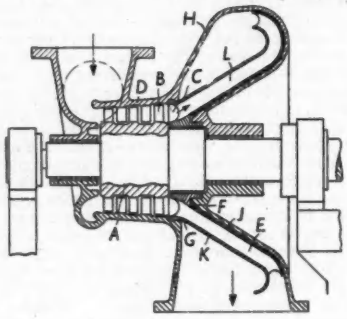

No. 695,331

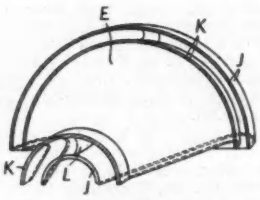
to both ends of the upper blade. Owing to this, the cuts in the metal sheet by both the extreme ends of the upper blade are performed simultaneously, with the result that the plate will be held firmly. Both the upper blade and the lower blade may consist of several elements fastened to the blade holders and each may be easily removed and replaced. In the third view the two points of the upper blade *A*, also cut simultaneously, but in this case the two starting points *H* are not at the ends of the upper blade but are nearer the centre, so that the cutting from both starting points is proceeding towards the centre as well as towards the ends of the blade; the cutting edge of the blade rises on both sides of the starting cutting points with a slope smaller than 10 deg. and is curved at the starting cutting points. In the bottom view all the parts of the upper blade form a slightly corrugated blade, the lower crests of the corrugations lying on the same level and cutting simultaneously. In this case the cuts always proceed in both directions, starting from the crests of the corrugations.—*August* 5, 1953.

## AIR COMPRESSORS AND TURBINES

**695,212.** October 19, 1950.—DISCHARGE CASING FOR AXIAL-FLOW COMPRESSORS AND TURBINES, Aktiengesellschaft fur Technische Studien, Hardstrasse 319, Zurich, Switzerland.

The aim of the invention is to provide a discharge casing for axial-flow machines which is of satisfactory aerodynamic shape and at the same time is cheap to manufacture. In the drawings *A* is the rotor of a turbine into which the working medium enters in the direction of the upper arrow and through which it flows in axial direction. The working medium, on leaving the last row of runner vanes *B*, flows into a short, substantially annular duct *C* inserted coaxially to the longitudinal axis of the machine into the casing *D*. The discharge duct *C* is connected to a two-part element *E* by welding at the points *F*




No. 695,212

and *G*, the element being mounted within the discharge casing *H*. The machine casing *D* is integral with the discharge casing *H*. Both the casings and the duct are separable into two parts on the horizontal plane passing through the longitudinal axis of the machine. The element *E* comprises two separate sheet metal shells *J* and *K* which are spaced to define between them a diffusing flow path. The duct *C* thus acts as a neck for the element *E*, the latter together with the neck forming a diffuser. The shells *J* and *K* are solids of revolution whose common axis forms the extension of the longitudinal axis of the turbine. The diffuser passage between the outer surface of the sheet metal shell *J* and the inner surface of the sheet metal shell *K* is so shaped that the kinetic energy of the working medium issuing from the last row of runner vanes *B* is converted into pressure with high efficiency. The shells, as shown in the drawings, are separable into two parts on a horizontal plane passing through the longitudinal axis of the machine, an arrangement which allows them to be separately machined outside the turbine and brought into the necessary form. In order that the radial distance between the two inserted sheet metal shells *J* and *K* may be maintained, substantially radial ribs *L* are provided between them. The axial-flow machines principally concerned apart from turbines are compressors and pumps.—*August* 5, 1953.

# Forthcoming Engagements

*Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of their insertion, the necessary information should reach this office on, or before, the morning of the Monday of the week preceding the meetings. In all cases the* TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

### ASLIB

*To-day to Mon., Sept. 11th to 14th.*—The University, Nottingham, 28th Annual Conference.

### BRITISH INSTITUTION OF RADIO ENGINEERS

*Wed., Sept. 30th.*—LONDON SECTION : London School of Hygiene and Tropical Medicine, Keppel Street (Gower Street), W.C.1, "The Impact of Communication Theory on Television," D. A. Bell, 6.30 p.m.

*Thurs., Oct. 1st.*—N.W. SECTION : College of Technology, Manchester, "The Detection and Cure of Parasitic Oscillations in Radio and Electronic Equipment," H. Whalley, 7.15 p.m.

### ENGINEERS' GUILD

*Thurs., Sept. 24th.*—METROPOLITAN BRANCH : Caxton Hall, Caxton Street, Westminster, S.W.1, Annual General Meeting, 6 p.m.

### INCORPORATED PLANT ENGINEERS

*Tues., Oct. 6th.*—EDINBURGH BRANCH : 25, Charlotte Square, Edinburgh, Members' Papers, 7 p.m.——LONDON BRANCH : Royal Society of Arts, John Adam Street, Adelphi, W.C.2, "Patterns, Casings and Foundry Work : An Introduction," Barnet Levy, 7 p.m.

*Wed., Oct. 7th.*—SOUTHAMPTON BRANCH : Polygon Hotel, Southampton, "Oxygen in Industry," E. Ryalls, 7 p.m.

*Thurs., Oct. 8th.*—N.E. BRANCH : Roadway House, Oxford Street, Newcastle upon Tyne, "The Use of Paint in Factories," P. J. Gay, 7 p.m.

### INSTITUTE OF BRITISH FOUNDRYMEN

*Wed., Sept. 30th.*—LONDON BRANCH : Waldorf Hotel, W.C.2, Presidential Address, B. Levy, followed by a Film and Report on "New Methods for Old," F. Hudson, 7 p.m.

### INSTITUTE OF MARINE ENGINEERS

*Tues., Sept. 22nd.*—85, Minories, London, E.C.3, Presidential Address, Sir Gilmour Jenkins, 5.30 p.m.

### INSTITUTE OF ROAD TRANSPORT ENGINEERS

*Wed., Sept. 16th.*—N.W. CENTRE : Victoria Hotel, Wigan, "The Use and Abuse of Fuels," W. E. P. Johnson, 7.30 p.m.

*Thurs., Sept. 17th.*—LONDON CENTRE : Visit by party of members to the main workshops, The Thames Valley Traction Company, Ltd., Reading, Berks, 1.45 p.m.——YORKSHIRE CENTRE : Hotel Metropole, King Street, Leeds, 1, "Vehicle Maintenance from the Aspect of Safety," A. H. Dack, 7.30 p.m.

*Tues., Sept. 22nd.*—N.E. ENGLAND GROUP : Royal County Hotel, Durham City, "The Maintenance of High-Speed Diesel Engines," H. L. Parrish, 7 p.m.

*Wed., Sept. 23rd.*—LONDON CENTRE : Visit by party of members to the works of Scammell Lorries, Ltd., Watford, Herts, 10.45 a.m.

*Wed., Oct. 7th.*—LONDON BRANCH : Royal Society of Arts, John Adam Street, London, W.C.2, Annual General Meeting, followed by "Transport in South Africa," T. F. Turton, 6.30 p.m.

### INSTITUTE OF WELDING

*Thurs., Sept. 17th.*—N. LONDON BRANCH : The Polytechnic, Regent Street, W.1, "Developments in Welded Pressure Vessel Manufacture," H. Harris, 7 p.m.

### INSTITUTION OF CHEMICAL ENGINEERS

*Sat., Oct. 10th.*—Reynolds Hall, College of Technology, Manchester, George E. Davis Memorial Lecture, Norman Swindin, 3 p.m.

### INSTITUTION OF ELECTRICAL ENGINEERS

*Sat., Sept. 12th.*—N.E. STUDENTS' SECTION : Visit to Cosmos Works of the Edison Swan Electric Company, Ltd., Sunderland, 10.30 a.m.

*Mon., Oct. 5th.*—S. MIDLAND CENTRE : Grand Hotel, Birmingham, Annual General Meeting, Chairman's Address and Conversazione, 6 p.m.

### INSTITUTION OF ENGINEERS AND SHIPBUILDERS IN SCOTLAND

*Tues., Oct. 6th.*—39, Elmbank Crescent, Glasgow, Presidential Address, Sir William Wallace, 6.30 p.m.

### INSTITUTION OF LOCOMOTIVE ENGINEERS

*Wed., Sept. 23rd.*—Institution of Mechanical Engineers, Storey's Gate, London, S.W.1, Presidential Address, R. C. Bond, 5.30 p.m.

### INSTITUTION OF MECHANICAL ENGINEERS

*Tues., Oct. 6th.*—AUTOMOBILE DIVISION : Storey's Gate, St. James's Park, London, S.W.1, Annual General Meeting, Address by the Chairman of the Division, 5.30 p.m.

### INSTITUTION OF POST OFFICE ELECTRICAL ENGINEERS

*Tues., Oct. 6th.*—ORDINARY MEETING : Institution of Electrical Engineers, Savoy Place, London, W.C.2, Chairman's Address, "Recent Developments in Subscribers' Apparatus and Services," F. C. Carter, 5 p.m.

### INSTITUTION OF PRODUCTION ENGINEERS

*Sat., Sept. 12th.*—BIRMINGHAM GRADUATE SECTION : Visit to Farnborough Air Display, 8 a.m.

*Tues., Sept. 15th.*—COVENTRY GRADUATE SECTION : Hare and Squirrel Hotel, Cow Lane, Coventry, Production Panel, Discussion on "Some Aspects of Production Engineering," 7.30 p.m.

*Wed., Sept. 16th.*—BIRMINGHAM SECTION : James Watt Memorial Institute, Great Charles Street, Birmingham, "The Ethics of Production," R. W. Mann, 7 p.m.

### IRON AND STEEL INSTITUTE

*Wed., Sept. 30th, to Wed., Oct. 7th.*—Special Meeting in the Netherlands.

### NEWCOMEN SOCIETY

*Fri., Sept. 25th.*—One-day Visit to Haddiscoe and Lound (near Lowestoft) to see grasshopper pumping engines.

### OLD CENTRALIANS

*Mon., Sept. 14th.*—Chez Auguste Restaurant, 47, Frith Street, London, W.1, "Litigation with Regard to Patents," G. W. Tookey, 12.45 p.m.

### ROYAL AERONAUTICAL SOCIETY

*To-day to Friday, Sept. 18th.*—LONDON : Anglo-American Conference. (See page 314.)

### SOCIETY FOR WATER TREATMENT AND EXAMINATION

*Thurs. to Sat., Sept. 17th to 19th.*—Autumn Meeting in Manchester.

### TELEVISION SOCIETY

*Thurs., Sept. 24th.*—Cinematograph Exhibitors' Association, 164, Shaftesbury Avenue, London, W.C.2, "Transistors and Other Crystal Valves," D. D. Jones, 7 p.m.